THE

COPERNICAN Philosophy

Contradicted by

PHÆNOMENA,

Price Three Shillings.

Lately Publiſhed, by the ſame Author, Price One Shilling and Six Pence:

The Divine Miſſion of the MESSIAH

Demonſtrated,

From the Eleventh Chapter of the Prophet *Daniel*: For the Conviction of *Jews* and *Deiſts*.

AN ESSAY ON THE HISTORY OF THE CREATION:

Wherein is ſhewn, that

THE

COPERNICAN Philoſophy

Is *Contradicted* by PHÆNOMENA:

And, that

The *MOSAIC* Syſtem

Is *Confirmed* from PHÆNOMENA.

Sidera Teſtes.

BY JAMES HURLY, *B. A.*
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VOL. I.

TAUNTON:
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THE PREFACE.

ALTHOUGH the title-page mentions the Copernican *ſyſtem alone as oppoſing the revealed hiſtory of the creation, which is eaſily ſupported by the open teſtimony of a few plain facts and phænomena; yet it is proper to inform the reader, that it is not my deſign, to attempt a defence of any ſyſtem of philoſophy beſides the* Moſaic. *The other ſyſtems agree with the* Copernican, *in almoſt all the points wherein that differs from the ſyſtem of nature revealed in the bible. They have alſo for a long time, been generally if not totally diſregarded, in compariſon of the*

Copernican *philosophy*; *which has been embraced by the most eminent philosophers abroad, as well as those of our own country, especially by Sir* Isaac Newton. *Hence it was sufficient for my purpose, to examine and refute the* Copernican *or, as it is sometimes called,* Newtonian *system: which of course is a refutation of the other systems, as far as they coincide with this in contradicting the Divine revelation.*

The points in which modern philosophy differs from the system communicated by Moses, *are the distances and magnitudes of the heavenly bodies in general, and the degrading the planetary lights in the firmament of heaven to the state and condition of the earth. The following treatise contains experimental proofs, that philosophers have been utterly mistaken, in these points wherein they differ from the account of the creation delivered by* Moses.

The plan which I have laid down in these papers seems to me unexceptionable; both for doing justice to philosophy, and also

to prepare the reader for a due consideration of the Mosaic *system. I have in the first place stated the doctrines of philosophers, which contradict the doctrine of* Moses: *and this I chose to do in their own words; that there might be no room for a charge of an unfair representation. Next I have produced the philosophical proofs in support of these doctrines: and these I have taken from such authors, as appeared to have pleaded their cause in the fullest and clearest manner, amongst those which I could consult. I have moreover given their arguments at large, as I found them; that they might want nothing of the force with which they came from the pens of their abettors. As there was first laid down a general state of philosophy, and then the particular proofs were introduced, in support of it's several parts: so in the third place, I come to take a general survey or review of these notions, and afterwards proceed to an examination of the several proofs. By which it should appear, that all the labour which has been employ-*

ed about the fabric of modern philosophy, has been able to effect no more, than to prove it a work of art, not of nature. For an examination of the merit of the philosophical arguments, shews them to deserve no better appellation than that of studied and laboured hypotheses. Which appears from facts and phænomena; enough of which I hope are cited in this essay to set aside a system unsupported by a single phænomenon.

Facts are an appeal to common sense; where every reader that pleases may judge for himself, whether he would chuse to follow truth or fiction. And it is much to be lamented, that the evidence of our senses is not more used, to promote the purposes for which we received them. It is certainly more becoming, for a man to employ his own eyes and understanding, in matters which by these means he may attain the knowledge of, as well as other men; than for the sake of avoiding a little trouble, to give himself indolently up to the direction of his fellow creatures; to travel with them, where their

fancies lead them; without a just foundation of pleasure or profit to himself.

I hope to be pardoned by philosophers, for entertaining an opinion, that if they had trusted to experiments of their own, rather than adhered to the prejudices of their predecessors, they might have given the world a valuable explanation of the ancient true system, and there would have been no occasion for removing at this time many obstacles, to come at the foundation of truth, upon which alone science can be raised. But favour is usually continued by mankind in general as they grow up in life, to the notions imbib'd in youth. And if we pass a strict judgment upon ourselves, it is to be questioned, whether any of us are intirely free from the effects of prepossession, in matters of more or less importance. We even collect with much trouble, all kinds of materials that may be brought to agree with our errour; and please our selves in raising structures with them, upon an unexamined foundation. The highest of mankind are subject to this human infirmity,

mity, perhaps altogether as much as the lowest of us. The method taken by the fam'd Mr. Huygens *to ascertain the distance of the star* sirius, *is a convincing proof, that a man of excellent abilities and accomplishments, may take a great deal of pains to confirm his errour, instead of discovering the truth. Who thought he had found out at last, that a bullet would spend almost seven hundred thousand years, in it's journey between us and the nearest of the fixed stars.*

I have not thought my self obliged to treat these groundless conceits, with much ceremony, although they have been indulged by men of reputation. And I hope, a regard for the truth will always have a much greater effect towards the determination of my words and actions, than any other regard whatsoever. The main consideration with me, is, that I may not deal unfairly with the authors of the notions which I have ventured to censure; so as to leave it doubtful, whether they have erected their system of philosophy upon a foundation of truth or errour.

And

And it is my ardent desire, that gentlemen who have it in their power to make the most accurate observations, will be pleased to examine the apparent diameters of the planets, as late as may be about the time of their respective conjunctions, which are all approaching: And that they will observe them again, as early as may be, after their conjunctions: And lastly, that they will observe them afterwards, as they think it pertinent or necessary: And that from these observations, made by themselves, they will determine whether I have judged rightly or not; and whether they have not been abused by prejudiced observers, and injudicious observations.

If any passages in these papers should appear exceptionable, which is very possible, especially as I have not had the advantage of assistance from any one, I will readily acknowledge the favour which any gentleman shall confer upon me, by candidly pointing out the supposed errours, and making his remarks upon the quality of their demerit. Of which I hope to take proper notice, by rectifying

the mistakes that shall be found in this volume, when I publish the second.

In which, if I am so happy as to be favour'd with the public attention to the first, I propose to examine distinctly the account which Moses *gives of the creation; and to shew, that it is exactly correspondent to phænomena. I have also prepared an explanation of* Sanchoniatho's *cosmogony, which I purpose to insert in the explanation of the* Mosaic *system. The author has been heretofore treated as an atheist by his learned expositors; but it will be shewn, that his fragment is a most valuable memorial of the earliest account of things, and coincides with the revealed history of the creation.*

An introduction is prefixed to the essay, wherein I have given a chronological table from the authority of classical writers, which connects the ages of the sacred history with the occurrences in Greek and Latin authors, from the time of Moses *and* Cadmus *to the reign of* Alexander *the great. I apprehend it may be extended with the same certainty,*

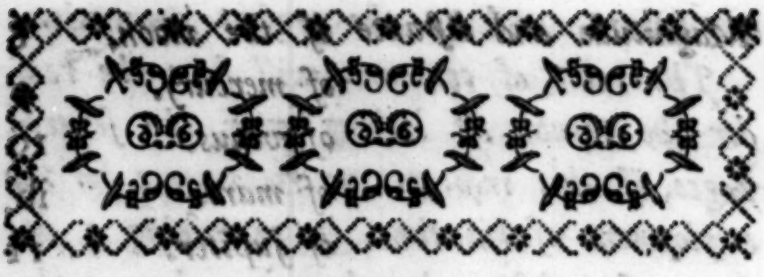
to

to Adam, *and to the present generation.*

The table of contents, will save the reader the trouble of looking over the several pages, if this indicates no recompence for the employment of his time, in examining a defence of a system that has been long exploded.

As what I have here written refers almost wholly to facts and phænomena, I cannot think it incumbent on me to take notice of any opposition that may be raised against me, if not founded upon as good authority.

Taunton-School-House,
February 2, 1765.



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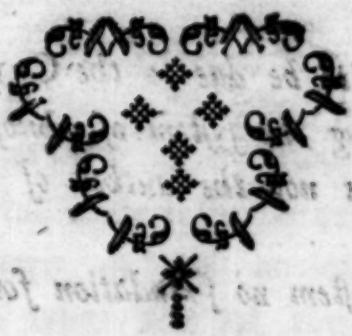

THE

INTRODUCTION.

THINK it is usual with those who undertake to celebrate the merit of any ancient author, to shew in what age of the world he flourished, and by what testimonies his character is supported. Something of this kind may perhaps be expected from me concerning Moses, as I have ventured to prefer his account of the creation before that of philosophers which differs from it.

The

THE INTRODUCTION.

I THINK it is usual with those who undertake to celebrate the merit of an ancient author, to shew in what age of the world he flourished, and by what testimonies his character is supported. Something of this kind may perhaps be expected from me concerning *Moses*, as I have ventured to prefer his account of the creation before that of philosophers which differs from it.

The

The time in which *Moses* lived is in a manner, I hope, ascertained from the following table, which makes out the connection between the sacred chronology and some memorable occurrences in profane writers, from the time of *Moses* to the age of *Alexander* the great.

As the generations in St. *Matthew* are counted from *Judah* the brother of *Levi*, from whom *Moses* was descended; it will be necessary to take notice, that *Moses* was in the same degree from *Levi* as *Aram* was from *Judah*: for *Judah* was the father of *Pharez*, the father of *Esrom*, the father of *Aram*. And *Levi* was the father of *Kohath*, the father of *Amram*, the father of *Moses*. *Judah*, *Pharez*, *Esrom*, *Aram*. Four. *Levi*, *Kohath*, *Amram*, *Moses*. Four.

It must be further remarked, that *Tydeus* was cotemporary with the sons of *Oedipus*; and *Diomede* his son was cotemporary with *Æneas*. Then the Generations from *Moses* and *Cadmus* may be thus compared.

I.

MOSES. *CADMUS.*

II.

Aminadab. *Polydorus.*

III.

Naasson. *Labdacus.*

IV.

Salmon. *Laius.*

V.

Booz. *Oedipus.*

VI.

Obed. *Tydeus.*

VII.

Jesse. *Æneas.*

VIII.

David. *Ascanius.*

IX.

Solomon. *Silvius.*

X.

Roboam. *Æneas Silvius.*

XI.

Abia. *Latinus Silvius.*

XII.

Asa. *Alba.*

XIII.

Josaphat. *Atys.*

XIV.

Joram. *Capis.*

XV.

Ozias. *Capetus.*

XVI.

Joatham. *Tiberinus.*

XVII.

Achaz. *Agrippa.*

XVIII.

Ezechias. *Romulus Silvius.*

XIX.

Manasses. *Proca.*

XX.

Amon. *Amulius.*

XXI.

Josias. *Romulus.*

XXII.

Jechonias. *Numa.*

XXIII.

Evil-merodach. *Tullus Hostilius.*

XXIV.

Belshazzar. *Ancus Martius.*

XXV.

XXV.

Cyrus. *Tarquinius.*

XXVI.

Cambyses. *Ser. Tullius.*

XXVII.

Darius. *Appius Claudius.*

XXVIII.

Xerxes. *Appius Claudius.*

XXIX.

Artaxerxes Macrochir. *C. Claudius.*

XXX.

Darius Nothus. *Appius Claudius Decemvir.*

XXXI.

Artaxerxes Mnemon. *Appius.*

XXXII.

Ochus. *Appius Claudius Crassus.*

XXXIII.

Arses. *Marcus Valerius Corvus.*

XXXIV.

Darius Codomannus. *Alexander.*

I cannot say, that *Livy* makes any mention of the father of *Appius Claudius* the decemvir; but *C. Claudius* is in divers places mentioned by him, as uncle of the decemvir, and son of the second *Appius*; which *Appius* is therefore the grand-father of the decemvir, from whom the two next generations are in lineal succession. Therefore the generations of the *Appian* family are perfectly ascertained to the time of *Valerius*. For in the same year that the last *Appius* in the table died, *M. Valerius* afterwards called *Corvus*, was of sufficient age to be a tribune of the Soldiers, and to engage a *Gaul*, who challenged any one of the *Romans* to a single combat. And this *Corvus* was a general that might have stood against *Alexander*, according to *Livy*, if he had attempted *Italy* instead of the east. Consequently he was cotemporary with the great grandson of the decemvir, as he also lived with *Alexander*, but was much older than *Alexander*, so that

that I have placed him in the preceding generation.

THAT the first of the *Appian* family in *Rome* was also coæval with *Tarquin* the proud, is evident from many circumstances in their lives; which shew that they were both advanced in years, *Tarquin* when an exile from his kingdom, and *Appius* when he left the *Sabines*, and gained a settlement for himself, and family, and dependents, in *Rome*. On these accounts, I am certainly justified in putting *Appius* where *Tarquin*'s place is according to the succession of the kings.

I am not ignorant, that *Livy*'s authority has been questioned, as differing from *Homer*, in bringing *Æneas* from *Troy* to *Italy*. But had it not been for the credit which the Author of the *Reflections on ancient learning* has obtained, the objection would scarce have deserved notice. *Homer* says it was destined for *Æneas*, that he and his posterity should reign over the *Trojans*. From hence the Author

infers

infers very injudiciously, that *Æneas* could not leave *Troy*, if he must reign over the *Trojans*. As if he could not reign over his *Trojans* in *Italy*, according to the faith of history. *Virgil*, without all doubt, understood the plain meaning of *Homer*, as well as the Author of the *Reflections*. Yet he agrees with the Historian in bringing *Æneas* to *Italy*; and is so far from thinking *Homer*'s authority against him, that he gives almost a literal translation of the passage objected in *Homer*, for the oracle which directed *Æneas* to *Italy*, after the taking of *Troy* by the *Greeks*, near the beginning of his 3d *Æneid*:

" Hic *domus* Æneæ *cunctis dominabitur oris*,
" *Et nati natorum, et qui nascentur ab illis.* "

Wherefore the reflection takes nothing at all from the extraordinary merit of the Historian, which has existed for the space of 1700 years and upwards.

THE *Persian* succession of generations is taken from *Justin* and *Plutarch*. And the ages from *Cadmus* to *Æneas* are taken

ken from *Homer* and *Euripides*. Therefore the table gives an authentic account of the generations as far as it extends: And I believe it is possible to continue it from *Moses* to *Adam*, and from *Alexander* to the present age, with equal authenticity. Whence it seems to promise something of utility in chronology.

ANCIENT authors give testimony to *Moses* his *character*, namely *Justin*, *Tacitus*, and *Longinus*. The two former describe him as a general, and a statesman. Also *Justin* makes particular mention of his excelling in knowledge, and being a goodly person. And *Longinus*, that admired critic, gives *Moses* a place amongst the sublime writers. We have yet the testimony of another author in favour of the *Mosaic* history of the creation, who may therefore be mentioned with the witnesses of his abilities. I mean *Sanchoniatho*, to whom if the authors before named are compared for antiquity, they are themselves but moderns. There is only a frag-

ment

ment of his remaining, communicated by *Eusebius*, and commented upon by Bp. *Cumberland*. The writer has been abused for that he was not understood. I purpose to take so much notice of this piece in my next volume, as will suffice to shew, that *Moses* his history of the creation agrees with the system delivered by *Ham* the son of *Noah* to the *Egyptians*. And upon this state it will appear, that the system of *Moses* was at first a revelation from heaven, and from the circumstances of the times, was well understood in the earliest ages; whose advantages for making astronomical observations, almost infinitely exceeded all the boasted assistances of the present times.

WHAT Dr. *Boerhaave* has said upon the burning of the calves made by *Aaron* at the request of the idolatrous *Israelites*, deserves also to be quoted in this place; as it is a testimony of that celebrated Chemist in favour of *Moses* and the ancient *Egyptians*; whose knowledge in chemistry

mistry he prefers to that of the moderns. "*The country where this art was first cultivated to advantage was that wherein the first man inhabited.* —— *From the place of it's rise it was propagated, like the other arts into* Egypt; *where it was vigorously prosecuted.* Moses, *who was skilled in all the learning of the* Egyptians, *was able to burn gold, so as to reduce it to a powder, capable of mixing with water, and fit to be drank: which is one of the highest effects of the art, and which the greatest chemists at this day are unacquainted with.*" *Shaw*'s translation of *Boerhaave*'s Chemistry, p. 13 and 14.

But the perfection of his character is to be sought in the holy scriptures, where we find abundant reason to esteem and admire the man, who has this testimonial at the close of his history, in the last chapter of the book of *Deuteronomy*, "*And there arose not a prophet since in* Israel *like unto* Moses *whom the* Lord

"*knew face to face, &c.*" And in the 3d chapter of the *Acts of the Apostles*, we see him even compared with the SON of MAN. "*For* Moses *truly said unto the* "*fathers, A prophet shall the* LORD *your* "GOD *raise up unto you of your brethren* "*like unto me; him shall ye hear in all* "*things, whatsoever he shall say unto you.*" v. 22. This character is far superiour to that of any mortal man, which was only inferiour to the glory of CHRIST.

I know it is usual to excuse a departure from the *Mosaic* system, by saying, that the Bible is written, not for the understanding the system of this world, but for our attaining the advantages of the next. And I am very well satisfied, that many Philosophers revere the memory of *Moses*, who are however of the opinion, that it was not necessary for him to speak of things as they are in nature; but that it was sufficient, if he wrote of the creation according to appearances, and the common notions in his days. On the other

ther hand, I cannot think it respectful to his memory, to imagine that a person of his character could set forth the history of the creation so particularly, as to count the progress made each day in that great work, and at the same time to express himself in terms so improper for his descriptions, that he is supposed to have put light for darkness.

TOUCHING the ancient notions of the system of the world, I have already intimated, that they had better opportunities of informing themselves by observations, besides their tradition from Revelation, than we have at present. This may seem a paradox. Yet I hope to make it evident, when I come to the explanation of the Divine system from *Mosaic* principles, that celestial bodies before the flood, were better observed and defined by the naked eye, than at this time by the best optical assistances. Add to this the advantages of repeating their experiments as often as they wanted to make

them

dam, in the first ages of the world, in the course of a man's life extending to many centuries of years.

In a word *Moses* had such superiour advantages, and superiour talents also, above all modern philosophers, that the utmost a man can wish for in philosophy, is, to attain as much as possible of the knowledge which *Moses* possessed of this kind. And no man ought to be offended for being told, that it is vanity and folly in any person whatsoever, to teach, that the wisest of philosophers did not understand philosophy, or was so inattentive to the subject upon which he wrote, that his words convey the notion of a contrary system to that which he had in his own mind, and which he took upon him to publish to the world, by the assistance of the Spirit of God.

An

AN ESSAY
ON THE
History of the Creation.

CHAP. I.

An Abstract of the Copernican *System of the World, so far, as it may be compared with* Moses's *history of the creation.*

THE *Copernican*, or if you please, the *Newtonian* System, fixes the SUN in the centre of the world. The EARTH is represented as moving round it, in a vast orbit, in the space of a year; and

 having

having another motion round it's axis, which is accomplished in 24 hours. So that according to this system, the earth is ranked amongst the planets; and is deemed as much a lucid body, as the moon, or any other of those moveable bodies which appear as lights or the world, in the firmament of heaven.

FOR these are asserted by philosophers, to be all alike opaque bodies; and to borrow that light from the sun, which is shewn to the inhabitants of the earth.

EVEN the sun and stars, as they tell us, differ only in nature from our terrestrial mansion, by their possession of intrinsic light and heat. Sir *Isaac Newton* gives his opinion upon the point, in the following words, "*Are not the sun and* "*fixed stars great earths, vehemently hot?* "*Whose heat is conserved, by the greatness* "*of the bodies, and the mutual action and* "*reaction between them, and the light which* "*they emit: and whose parts are kept from* "*fuming*

"*fuming away, not only by their fixity, but*
"*also by the vast weight and density of*
"*the atmospheres incumbent upon them, and*
"*very strongly compressing them, and con-*
"*densing the vapours and exhalations, which*
"*arise from them.*" Optics, b. 3. qu. 11.

It might be objected, that a body heated in this manner must gradually lose his heat, and in length of time become cold. Therefore in the next page, the author endeavours to obviate such an objection. He says, "*The great weight of*
"*the atmosphere which lies upon the globe*
"*of the sun, may hinder bodies there from*
"*rising up, and going away from the sun,*
"*in the form of vapours and fumes; un-*
"*less by means of a far greater heat than*
"*that which on the surface of our earth,*
"*would very easily turn them into vapours*
"*and fumes. And the same great weight*
"*may condense those vapours and exhala-*
"*tions, as soon as they shall at any time*
"*begin to ascend from the sun; and make*
"*them presently fall back again into him;*

"and by that action increase his heat, much
"after the manner that in our earth the
"air increases the heat of a culinary fire.
"And the same weight may hinder the globe
"of the sun from being diminished, unless
"by the emission of light, and every small
"quantity of vapours and exhalations."
And in his *Principia*, he gives his opinion, that the sun and stars may be assisted by comets falling upon them, to repair their decaying light. "*Cometa qui anno 1680 apparuit, adeo dilabitur in solem perhelio suo quam partes sexta diametri solis; et propter phenomena cometarum in vicinia illa, et longissime adhuc supra solem, refrigeratione indigere quam fere debent, et atmosphaerarum densitatem esse propius ad solem ad hanc rem sufficiens, revolutionibus cometarum ad solem, quibus in tandem in corpus solis. Sed et in systemate hujus terrestre nostrum, aliquando per attractionem alterum cometarum retardari potest, et solvendo in solem possit. Sic etiam stellae fixae, quae pabulum emittunt in*

"in lucem et vapores, consumi in ipsas re-
"cidentibus resici possunt, et novo alimento
"accensa pro stellis novis habere. Hujus ge-
"neris sunt stellæ illæ, quæ subito appa-
"rent, et sub initio quam maxime splendent,
"et subinde paulatim evanescunt." lib. 3;
p. 525. Edit. Lond. 1726.

THE vast dimensions which are ascribed to the sun, are intended also to account for the retention of his heat. This is assigned as a reason by Dr. *Harris*, in his astronomical dialogues p. 76. "*According to these ways of computation* "*the sun's diameter, or his breadth from* "*one side to the other, is about* 800,000 "*miles; which is above* 100,000 *times* "*greater than the diameter of our earth;* "*and therefore his bulk, or rather the quan-* "*tity of matter in the sun, must exceed that* "*of the earth above* 10,000,000 *times.* "*And this consideration of the sun's vast* "*magnitude, will account for the query you* "*rightly enough stated, how he can so long* "*continue his heat without any sensible di-*

"*minution.*

"*minution.* — *And as to the daily expence of his light and heat; the particles of light are so infinitely small, that out of a body so big as the sun, they may be sent for many hundred thousands of years together, without any sensible lessening of his bulk, weight or magnitude.*"

THE reason why the sun appears so small to the inhabitants of the earth, according to philosophers, is owing to his prodigious distance; which, as the last mentioned author informs us, is about 70 or 80 millions of miles. This was astonishing to his fair disciple, who expresses her surprize in these words; "*Eighty millions of miles! said she, why you fright me, my head turns round, and I am giddy with the very notion of it.*" p. 75.

THE magnitudes and distances of the planets are suitable. The diameter of the MOON "*is reckoned to be almost* 2200 *miles.*" p. 107. "*Her distance* 240,000 *miles.*" p. 93. Concerning the other planets, we read as follows,

"MERCURY

"MERCURY *is a planet whose diameter we reckon to be about* 2700 *miles; and therefore he is about two thirds of the earth's magnitude. His distance from the sun is about* 32 *millions of miles; and his mean distance from us about* 22,000 *of the earth's semidiameters, or* 88,000,000 *miles according to* Cassini's *numbers. He revolves round the sun in something less than* 88 *days, with the velocity of* 100,000 *miles in an hour; which is almost as fast again as the earth travels; for we don't go above* 56,000 *miles in that time, and yet that is making pretty good speed too, for that don't want much of* 1000 *miles in a minute, or* 15 *miles in a second, or in that space of time, in which you can distinctly pronounce, one, two, three, four. And yet however amazingly swift this may seem, 'tis crawling like the* American Ignavus, *or beast called the* Sluggard, *in comparison of the velocity of the rays of light, which certainly move about* 180,000 *miles in that time.*"

"*time.*" p. 110. The lady is astonished at this also. "*What! in a second, said* "*she: let me see, — why that is almost* "50,000 *miles while I can say the word* "*light. For godsake stop a little, or you will* "*make me perfectly giddy. My head will* "*turn quite round. What! have you and* "*I been travelling almost* 2000 *miles together, this morning, and I knew nothing* "*of the matter?*"

"*The distance of* VENUS *from the sun* "*is about* 60 *millions of miles.*" p. 115. "*She is about the bigness of our earth.*" p. 117.

"*They account the diameter of* MARS "*to be about* 4,400 *miles, and therefore* "*he must be much less than our earth.* "*And his distance from the sun is about* "123,000,000 *miles.*" p. 122.

"JUPITER *is the largest of all the* "*planets: and you see by the general scheme,* "*that he is much more remote from the* "*sun, than any of the inferior planets we* "*have already been discoursing of; and*

"*therefore*

therefore he hath granted him "a supply of light by 4 moons, or satellites, which revolve round him as our moon doth round us." p. 124. "*His diameter is above 80,000 miles: and the quantity of matter in him is about 220 times greater than that of our earth: and his distance from the sun about 424 millions of miles.*" p. 126. As for the distances of his satellites, "*the nearest is about 130,000 miles from that planet; the second about 364,000; the third 580,000; and the fourth or outermost is about a million of miles distant from him.*" p. 127.

SATURN, "*the outermost planet in our system, is at a very great distance from the sun, about 777 millions of miles. His diameter is about 61,000 miles: and with regard to the quantity of matter in him, 'tis about 94 times as great as that of our earth.*" p. 131. "*The innermost of these moons is distant from him about 146,000 miles. The second is distant from him about 187,000 miles.*

" *The third is distant from the centre of* " *Saturn about* 263,000 *miles. The* Huy- " genian *satellite is about* 600,000 *miles* " *from him. The last is* 1,800,000 *miles* " *distant from Saturn.* " p. 132. Our author likewise informs us, that " *the largest* " *of all these, and which is the only one* " *commonly seen, is the* 4*th in order from* " *his body, and he bears the name of the* " Huygenian *satellite, because first discover-* " *ed by Mr.* Huygens. " ibid. *But the most* " *surprising and unparallel'd phænomenon of* " *all in this planet, is that which we call* " *his ring. 'Tis a vast body of earth, as* " *is most probable, of perhaps* 7 *or* 800 " *miles in thickness: which, at the distance* " *of about* 21,000 *miles from Saturn's body,* " *and with just as great a breadth, is* " *placed in a circular arch round about the* " *planet, in figure much like the great wood-* " *en crane wheels, in which men or horses* " *walk to raise goods or to draw water.* " *'Tis placed exactly over the equator of Sa-* " *turn, and is not any way contiguous to*

" *his*

" *his body, nor supported by any thing. The* " *surface of this ring, is not rough and* " *full of hills and protuberances, as that of* " *the moon in most places is, but even and* " *plain, as it is in those regions of the* " *moon, which some, because of their great* " *evenness have judged to be seas.*" p. 134.

In this chapter I have briefly set down the philosophical doctrine, touching the motion of the earth, and the opacity, magnitude, and distances of the planets. The next chapter contains the proofs, by which this doctrine is supported.

CHAP. II.

The proofs alleged in support of the preceding doctrine.

THAT I may not be accused of a partial representation of the proofs advanced by philosophers, in confirma-

tion of what they assert concerning the motion of the earth: I have transcribed Dr. *Gravesande*'s account of the earth's motion, as I find it in Dr. *Desagulier*'s translation. Mathemat. elem. vol. 2. b. 4. c. 13. "*That no doubt may be made con-*
"*cerning the system which has been explain-*
"*ed in the first chapter of this book; we*
"*must here prove the motion of the earth.*
"*Concerning which it is no wonder that*
"*many have doubted: for the celestial mo-*
"*tions cannot be determined by us, but by ob-*
"*servations made by observers on the earth:*
"*and the same phænomena appear, whether*
"*the bodies themselves be moved, or the*
"*spectator be moved. So that it is not to*
"*be proved by immediate observations, whe-*
"*ther the motion of the earth is to be re-*
"*ferred to the heavenly bodies or not. That*
"*the earth is carried about the sun, is de-*
"*duced from the analogy of the motions,*
"*and from an examen of the laws of na-*
"*ture. As to what relates to the analogy*
"*of the motions, it is to be observed, that*

"*satellites*

" *ſatellites revolve about jupiter and ſaturn,*
" *which are leſs than the central body. That*
" *the moon revolves about the earth, than*
" *which it is leſs. Laſtly, that the ſun has*
" *revolving about it leſs bodies than it ſelf,*
" *as mercury, venus, mars, jupiter, and ſa-*
" *turn. Now if the earth revolves with the*
" *reſt, then every where in our ſyſtem the*
" *leſſer bodies move about the greater. Now*
" *there would be an exception in this rule,*
" *in reſpect of the ſun, if that* vaſt body
" *was to go round ſo ſmall a body as the*
" *earth.*

" *About the ſun, jupiter, and ſaturn, a-*
" *bout which ſeveral bodies revolve, thoſe*
" *move the ſloweſt, which are moſt diſtant*
" *from the central body, and according to*
" *this rule, that the ſquares of the periodi-*
" *cal times follow the ratio of the cubes*
" *of the diſtances. Which rule may be ap-*
" *plied to the earth, if it be carried about*
" *the ſun, with the reſt of the planets, as*
" *appears, if it's periodical time, namely the*
" *time in which the ſun appears to per-*

" *form*

"*form an intire revolution, and it's dis-*
"*tance from the sun, be compared with the*
"*distances and periodical times of the rest*
"*of the planets. Now this rule has only*
"*one exception, if the sun be moved about,*
"*the earth is at rest. In this case, mer-*
"*cury, venus, mars, jupiter, and saturn are*
"*subject to this rule in their motions, as*
"*also the five satellites of saturn, and the*
"*four planets that accompany jupiter. On-*
"*ly the moon, and the sun, would move*
"*about the earth, in a proportion quite*
"*different; and then the celerity of the sun*
"*would not only be greater than is requi-*
"*red by this law, but it's velocity would*
"*at least be six and twenty times greater*
"*than that of the moon, though it be moved*
"*to a vast distance from the earth, in re-*
"*spect to the moon's distance. And there-*
"*fore in this respect, the analogy of the*
"*celestial motions would be disturbed.*

"*To these arguments I shall add others,*
"*whereby it will clearly appear, that the*
"*motion of the earth is a necessary conse-*

"*quence*

" quence of the laws of nature, which are
" deduced from phænomena. All bodies gra-
" vitate towards one another, therefore the
" sun and earth do. But the motion where-
" by these bodies tend towards one another,
" is deduced from direct observations. Which-
" soever of these bodies moves about the other
" describes areas by lines drawn to the cen-
" tre of it proportional to the times, which
" is evident from astronomical observations:
" therefore the body is retained in a curve,
" by a force which is directed to the cen-
" tre of the other. Now as reaction is al-
" ways equal to action, unless the laws
" of nature, which obtain constantly every
" where, be wholly overturned, these two
" bodies tend towards one another with e-
" qual motions, that is, with celerities that
" are inversely as their masses: which is
" also immediately deduced from the law of
" gravity. The quantity of matter in the
" earth is next to nothing, in comparison
" to the quantity of matter in the sun;
" wherefore the sun must move very slow-
" ly,

" ly, whilst the earth comes towards it very
" swiftly. Whence it follows, that the earth
" is carried round the sun, lest it should
" fall upon the sun by the very violent mo-
" tion whereby it is retained in it's or-
" bit.

" The motion of the earth is also dedu-
" ced from the same principles another way.
" Two bodies that are carried towards one
" another by any force, will at last con-
" cur, or continually recede from one ano-
" ther: unless each of them be so moved,
" as to have a centrifugal force, equal to
" the force whereby it is carried towards
" the other body. But as the bodies which
" gravitate towards one another, tend to-
" wards each other with equal forces, or
" which is the same, with celerities that
" are inversely as the quantities of matter;
" these bodies cannot persevere in their mo-
" tions about one another, unless both of
" them be so moved, as to have equal cen-
" trifugal forces: which does not happen,
" unless they both revolve in equal times

"about their common centre of gravity: "that is, if this proposition be applied to "the sun and earth, unless they both move "about a point, whose distance from the "centre of the sun is to it's distance from "the centre of the earth, as the quantity "of matter in the earth is to the quantity "of matter in the sun, they cannot perse-"vere in their motions about one another. "This point or centre of gravity, must of "consequence be very near to the sun's cen-"tre. Now since whichsoever of these bodies "moves, it perseveres in it's motion about "the other; it follows, that both of them "are affected by the motions abovemention-"ed, and that the sun is moved but a lit-"tle, whilst the earth describes a very great "orbit. Whence it follows, that the motion "of the earth cannot be denied by any one "who reasons from the laws of motion that "are deduced from phænomena.

"Having proved the annual motion of the "earth, and brought back the earth amongst "the planets; there remains but little dif-

"ficulty in relation to the motion of it a-
"bout it's axis; for no body that believes
"the annual motion doubts of this. A great
"many which allow of the motion about
"the axis deny the annual motion: there-
"fore it will be enough to observe by the
"by, that all the planets concerning which
"any observation could be made in respect
"of this motion, do move about their axis;
"and that the earth has such a motion,
"the uniform diurnal motion in bodies at
"any distance, does plainly enough shew. To
"which we must add, that the celerity of
"the fixed stars, going through one whole
"revolution in less than 24 hours, can
"hardly be more probable than it is con-
"ceivable.

"This motion also is disagreeable to the
"nature of all the heavenly bodies. For if
"they are carried round, they must every
"day with an equable motion describe cir-
"cles that have the earth for their centre;
"that is, they must by lines drawn to the
"centre of the earth, sweep through areas
"proportionable

"*proportionable to the times, and be retain-*
"*ed in their orbits by forces which are di-*
"*rected towards the centre of the earth,*
"*and by which, by reason that action and*
"*reaction are equal, the earth must also be*
"*continually attracted towards those bodies;*
"*so that it must necessarily be agitated by*
"*a very violent motion: whence it appears,*
"*that the diurnal motion must not be refer-*
"*ed to the heavenly bodies, but to the ro-*
"*tation of the earth about it's axis.*"

THE reasons assigned for the opacity of the moon and the other planets, are concisely delivered in *Regnault*'s Philosophical Conversations, rendered by Dr. *Dale* in the following words, "*The pla-*
"*nets (I don't here speak of the sun) are*
"*opaque and solid bodies. For their inter-*
"*position with-holds from us the light of*
"*the superior luminaries, and only reflect a*
"*borrowed light, since they have their dif-*
"*ferent phases, that is, divers parts en-*
"*lightened, or without light, in proportion*
"*as they change situation with regard to*

"*the sun and the earth.*" vol. 3. p. 168. And the same author says particularly of the moon's opacity: "*One cannot doubt,* "*but that the moon is an opaque and solid* "*body. For not only are the same parts of* "*the moon sometimes enlightened, and some-* "*times obscure, but when she happens to be* "*directly between the sun and our eyes, she* "*deprives us of the light of the sun, she* "*loses her own, and is covered with dark-* "*ness when the earth is between her and* "*the sun.*" p. 170. And whereas one would judge the moon to be a light body, from her appearing intire, though with a faint light, at the time of the new moon, when she cannot receive that light from the sun directly, whereby she is rendered visible to us; this is said to be reflected light from the earth, and not the natural and proper light of the moon. The author last mentioned accounts for this phænomenon, in the following manner, p. 175. "Arist. *But when* "*it is fair weather, and the moon is in*

"*her*

"her decrease or in her increase as at present,
"why do we still see this luminary's body,
"at least confusedly? Eudox. Because the
"rays of the sun, being reflected by the earth
"toward the obscure part of the moon, make
"it appear, at least confusedly, as the rays
"of the sun reflected by the moon upon the
"surface of the earth, would make it seen
"by eyes which looked upon it from the
"moon. Accordingly, this second light of the
"moon is much more lively, when the moon
"is still near the sun, than when she is
"in her quarters: because when she is near
"the sun, the obscure part receives the light
"reflected by the whole surface of the earth,
"which is wholly opposite to her, and which
"is all enlightened, with respect to her.
"But when the moon is in her quarters,
"where her distance from the sun is 90
"degrees; there is only the half of this
"surface enlightened which can diffuse it's
"reflected light upon the obscure part of
"the moon: and these rays being more ob-
"lique, are reflected in smaller number to

"our

"*our eyes. Hence when the moon is in her*
"*decrease, and approaches to her conjunc-*
"*tion, this reflected light is stronger, be-*
"*cause it proceeds from eastern countries,*
"*where there are fewer seas. In the first*
"*phases after the new moon this light is*
"*weaker, because it proceeds from western*
"*countries, where there are more seas. The*
"*land remits more light than water.*"
Lastly, a reason is given also, why the moon may be visible in her eclipse when the earth intercepts the light of the sun; and yet have no light of her own, by which she is made visible to us. "*Scil.*
"*in eclipsibus lunæ totalibus, etiam dum lu-*
"*na prope centrum umbræ versabatur sæ-*
"*pius ea visa est tenui pallidaque luce per-*
"*fusa: mirum fortasse plerisque videbitur*
"*unde oritur hæc lux: quidam enim eam*
"*lunæ nativam esse suspicabantur, alii a stel-*
"*lis planetisque eam deducebant. Nam inter-*
"*positio telluris, omnius solis lucem a luna*
"*arcere, et densissimis tenebris conum um-*
"*brosum involvere videretur. At vero, cum*

"*terram*

" *terram amplectatur sphæra aeris, satis crassa, et vi refractiva pollens, illa solis radios e medio rariore obliquissime in se incidentes e propria directione detorquet, itaque illos refranget ut umbrosum spatium pervadant lucis solaris radii, lunæque corpus inter positum illustrent, illudque nobis conspicuum reddant.* " *Keill.* Astro. p. 184.

HAVING presented the reader with what seemed to me the best authorities that I could either recollect or come at, for proving the moon and all the planets to be opaque bodies: I shall in the next place set down the proofs, which are adduced for the magnitudes and distances of these bodies.

DR. *Keill* endeavours to prove the sun a greater body than the earth, from a phænomenon attending eclipses of the sun. Lect. 11. p. 119 and 120. " *Sciendum est, corpus omne lucenti soli expositum umbram projicere in plagam soli oppositam: estque hæc umbra nihil aliud*

" *quam*

" quam privatio lucis in spatio quodam, ob
" solis radios ab opaco corpore interceptos.
" Adeaque terra, opaca cum sit, umbram
" projiciet in plagam soli oppositam, in quam
" si incurrat luna, eam obtenebrescere neces-
" se est. Et quia figura telluris est sphæ-
" rica, umbræ figura cylindrica foret, si
" terra solem magnitudine æquaret: aut si
" solem superaret, figura umbræ esset coni
" vertice truncati et crassitie crescens; et in
" utroque casu umbra in infinitum porrige-
" retur; aliosque planetas, martem scil, jo-
" vem, et saturnum, tenebris suis involve-
" ret. Quod cum nunquam facit, necessa-
" rio erit terra sole minor; in quo casu,
" figura umbræ est conica in apicem desi-
nens. "

THE same author, p. 135, gives us the proof, from whence the moon's distance from the earth, is calculated by eclipses to be about 60 semidiameters of the earth, in these words, " Cum terræ
" diameter sit ad diametrum lunæ ut 100
" ad 28, erit altitudo coni terrestris ad al-

 " titudinem

" *titudinem coni umbrosi lunæ, in eadem ra-*
" *tione, sunt enim figuræ similes, adeoque*
" *erit æqualis* 59.36 *semidiametris terræ.*"
The earth's semidiameter is nearly known, and contains, as has been already observed, about 4000 miles. Therefore 60 of these semidiameters is 240,000 miles; which agrees with Dr. *Harris*'s calculation. I pass by for the present the proofs of the distances of the planets from their parallaxes; that I may come the sooner to consider the *phænomena*, which overthrow the *Copernican* system.

For the like reason, I forbear also to transcribe that proof of the distances of the stars, which respects the parallax of the annual orbit: for this is admitted to be *nothing* in the stars, and therefore nothing can be proved by it. " *At in*
" *stellis fixis* nulla *deprehenditur parallaxis*
" *orbis annui.*" *Keill.* p. 217. But another argument is brought, to prove the stars at immense distances, from the use of *telescopes*. Which is thus expressed by

Gravesande, p. 202. "*That the fixed stars* "*are at an immense distance, is also proved* "*by observations with the help of telescopes.* "*If any fixed star, even the lucid and con-* "*spicuous, be beheld with a telescope, through* "*which the diameter of the sun would ap-* "*pear equal to the diameter of the earth's* "*annual orbit; it will appear to be a lu-* "*cid point, without* any sensible magni- "tude. *For* all *the fixed stars appear* less "*when they are seen through telescopes, than* "*they do to the naked eye: for it is only* "*their twinkling which makes them appear* "*to have any sensible magnitude.*"

If the distances are proved, the magnitudes must bear some proportion to them: wherefore I add nothing concerning the magnitudes of the celestial bodies, but proceed to consider the merits of the arguments already quoted.

CHAP.

CHAP. III.

Containing a review of the philosophical system.

FROM this view of the proofs, for the establishment of the philosopher's system, in opposition to that which is revealed in the bible; let us now examine, whether there be indeed such merit in these arguments, that they should cause us to reject the revelation of GOD.

THE philosophers boast, that theirs is a *glorious system*: I rather apprehend, if it be fairly examined, there will appear nothing but rudeness in these gigantic structures. One of the principal ornaments in nature is *variety*, which has here no place. For these vast bodies are *all earths*. Sun, stars, planets, all are earths. Some of them indeed have great-

er dimensions, or greater densities than others: but besides this difference in their quantity of matter and bulk, I do not find any other distinction among them, at their first philosophical formation. Upon these principles, our earth is in heaven with her planetarian kindred. "*His indubiis rationibus adducti, tellurem in cælum inveximus, et inter planetas posuimus; solemque ad centrum detrusimus.*" *Keill.* p. 36. So man was originally placed in heaven, when he was created and stationed upon the earth, and commanded to look up from thence to heaven, as the place of future happiness; which he should strive to attain, by doing the will of God upon earth. Doth not such philosophy teach men, that it is a matter of little consequence, whether they take any pains, to obtain a better place than this earth affords? They are already, as the philosopher saith, in heaven, and are as happy as the inhabitants of other mansions there, for any

thing

thing that may be known to the contrary from his doctrine.

THE heating or rather burning these earths, to turn them into suns and stars, for enlightening the planets, is a wild conceit. Out of the almost infinite number of astronomical earths, seventeen visible ones only have escaped the philosophers fire. The rest are almost secured from the approach of any of their kindred, by the excessive fervency which astronomers have given them. Not intirely however; for the comet of 1680 wandered so near to the sun, that it fell into a degree of heat exceeding the heat of summer 28,000 times. "*Cum distantia cometæ a centro solis Decemb. 8. ubi in perihelio versabatur, esset ad distantiam terræ a centro solis ut* 6 *ad* 1000 *circiter; calor solis apud cometam eo tempore erat ad calorem solis æstivi apud nos, ut* 1000000 *ad* 36, *seu* 28000 *ad* 1." Which is esteemed 2000 times greater than the heat of glowing iron. "*Sed calor*

"lor aquæ ebullientis est quasi triplo major "quam calor quem terra arida concipit ad "æstivum solem, ut expertus sum: et ca- "lor ferri candentis, (si recte conjector,) "quasi triplo vel quadruplo major quam ca- "lor aquæ ebullientis; ideoque calor, quem "terra arida apud cometas in perihelio ver- "santem ex radiis solaribus concipere posset, "quasi 2000 vicibus major quam calor fer- "ri candentis. Tanto autem calore vapores "et exhalationes, omnisque materia volati- "lis statim consumi ac dissipari debuissent."

The comet acquired such immense heat from the sun at that time, that Sir *Isaac* is of opinion, it could hardly be cool again in the space of 50000 years. "Co- "meta igitur in perihelio suo calorem im- "mensum ad solem concepit, et calorem illum "diutissime conservare potest. Nam globus "ferri candentis digitum unum latus, calo- "rem suum omnem spatio horæ unius in "aere consistens vix amitteret. Globus au- "tem major calorem diutius conservaret in "ratione diametri: propterea quod superficies

(ad

" *(ad cujus mensuram per contactum aeris*
" *ambientis refrigeratur) in illa ratione mi-*
" *nor est pro quantitate materiæ suæ ca-*
" *lidæ inclusæ. Ideoque globus ferri can-*
" *dentis huic terræ æqualis, id est, pedes*
" *plus minus* 40000000 *latus, diebus toti-*
" *dem, et idcirco annis* 50000 *vix refrige-*
" *sceret.* " Princip. p. 508, 509. Such a notion of glory, is better adapted to the conceptions of the barbarous Germans, mentioned by *Cæsar* in the 4th book of his commentaries, than to the sentiments of a Christian philosopher. They accounted it their greatest glory to have all the countries adjacent to them an uninhabited wilderness: whereby it might be thought, that the terror of their arms, kept their fellow creatures at an immense distance from them. The *Suevi* were so influenced by this notion of glory, that the country was a desart, on one side of them, for the space of 600 miles. Their barbarity appears incredible to the annotator *in usum Delphini*;

phini; and there seems to be greater reason, that the notion of desarts in heaven, should appear equally incredible, to all that set a proper value upon what is called common sense.

CHAP. IV.

The philosophical arguments for the earth's motion examined and refuted.

THIS general view is no way favourable to the *Copernican* system; but let us come to particulars, beginning with the motion of the earth. All the force of argument, in that large extract from *Gravesande* contained in the 14th and following pages, rests upon two suppositions: first, that the sun is vastly larger than the earth; and secondly, that the earth is of the same nature with any or all of the planets. That the first

is

is nothing but hypothesis, may be directly proved from *Gravesande* himself, p. 158. "*To give a notion of the dimensions* "*of the bodies themselves in our system, we* "*have contrived the figure, in which all* "*the primary planets and saturn's ring are* "*described according to their dimensions. The* "*sun whose magnitude exceeds all the rest* "*is represented by the greatest circle. These* "*dimensions represent the proportions of the* "*bodies one to another exactly enough, if* "*you* except the earth; which cannot "be so compared with the other bo-"dies, as to leave no room to doubt "what proportion it bears to them." But if the earth cannot be compared with the heavenly bodies, the dimensions of the heavenly bodies cannot be ascertained in any earthly measure, as lines, inches, feet, or miles. As long as the proportion is observed between the sun and planets in their dimensions, a line will serve for a measure as well as a mile. And the sun's diameter may be

eight inches, or eight hundred thousand miles, without making any difference in the proportion of the system. Hence we see clearly, that the sun may be infinitely less than the earth, in a truer sense than it can be infinitely larger. Neither are the proportions which astronomers have settled in their system, to be absolutely depended upon: for *venus* since the late transit, "*is reduced to nearly one* "*half of it's former* supposed *magnitude.*" Young Gentleman and Lady's Philosoph. p. 257. That the notion of the earth's having the nature of a planet, is an hypothesis also, will be presently demonstrated, when I come to shew that the planets are not opaque bodies.

AGAINST these hypotheses for the earth's motion, I will put a plain demonstration of it's quiescence.

THE supposed circuit of the earth may be compared to a sailing vessel; and the inhabitants of the earth may be regarded as passengers in this vessel.

Which

Which ſails according to the *Copernican* hypotheſis, from *cancer* to *capricorn*: and from *capricorn* ſhe comes about to *cancer* again; and then the voyage is compleated. Now if men go in a veſſel from hence to the *Cape Verd iſlands* only, at the ſeaſon of the ſummer ſolſtice, they muſt paſs under the ſun, and leave it behind them. Therefore if the earth ſailed from the northern extremity of the ecliptic to it's ſouthern limits, from *cancer* to *capricorn*; we muſt paſs under the ſun, and leave it behind us; as they do in ſailing to the iſlands before mentioned. But it is certain, that we never arrive ſo near the ſun, as to have it vertical, in our imaginary voyage. Therefore it is certain, that the earth doth not ſail or move from one extremity of the ecliptic to the other. *Q. E. D.*

THIS is not the *only* demonſtration, that may be expected in this volume, of the earth's immoveableneſs.

CHAP. V.

The opacity of the planets disproved.

THE proof of the opacity of the planets was, that "*they have their* "*different phases, that is divers parts en-* "*lightened or without light, in proportion* "*as they change situation with regard to* "*the sun and earth.*" Two planets then *in the same situation with regard to the sun and earth*, will have the same phases: *venus* and the moon being both in the same situation, must have the same phases; or else the notion contradicted by phænomena is a groundless hypothesis. But the moon is in the same situation with *venus*, and with every one of the planets, once in every month, as she passes through the several parts of her orbit in or near the ecliptic. Yet the planets do not assume the phases of the

moon

moon, at the times of their conjunction with her in the month: therefore what has been called a proof of the opacity of the planets is no more than hypothesis. For at the time of the full moon, in the month of *July* last, the heliocentric place of *venus* was in the same sign with the moon: and therefore being nearly *in the same situation with regard to the sun and earth*, the appearance of *venus* ought to have agreed nearly with the appearance of the moon. The contrary to which happened; *venus* being then decreased to the smallest form almost that she is capable of, as her horns had been lessening for a long time, and she was drawing very near her conjunction with the sun. So the phases of these two planets, were as different from each other, as the phases of a full moon and a new moon: when upon *Copernican* principles they ought to have been alike. "*Pro* "*vario telluris respectu veneris et solis situ,* "*varia erit forma atque figura sub qua*

"*venus*

" *venus conspicietur; phasesque subibit lu-*
" *ne phasibus per omnia similes.*" *Keill.* p. 192. From hence it may be judged, whether there be a proper foundation, for that boasting amongst the followers of *Copernicus*, how he foretold what has been since manifested, that in after times, astronomers might discover venus to have like phases with the moon; although this could not be proved in his days, for want of telescopes. " *Hanc* Copernici *præ-*
" *dictionem primus implevit magnus* Gali-
" læus *philosophus* Linceus, *qui telescopi-*
" *um ad venerem dirigens, eam phasibus suis*
" *lunam æmulari deprehendit, quod systema*
" Pythagoricum *mirifice confirmavit.*" p. 194.

But does not the moon borrow her light from the sun? I say it does not. And of this I will give full proof.

First, An extract from Dr. *Keill* in p. 24th shews, that astronomers acknowledge the moon to be oftentimes visible in her eclipse; when the enlighten-

ed

ed face is hid from us in the ſuppoſed ſhadow of the earth, whoſe interpoſition between the ſun and moon takes off all the rays of light paſſing in direct lines from the ſun to the moon. This difficulty they endeavour to ſolve, as was there ſhewn by a quotation from the ſame learned gentleman, then *Savilian* profeſſor, by ſaying, that the power of refraction bends the rays of the ſun, ſo as to bring them between the moon and an obſerver of the eclipſe, thereby enlightening the moon, and rendering her face viſible to a ſpectator. But what power can afterwards convert this light into darkneſs, to compleat their ſhadow of the earth? It is the unqueſtioned property of light, to diſpel darkneſs; not to be convertible into darkneſs: and to diſſipate ſhadows; not to be made a ſhadow. Therefore the argument for the moon's light from this phænomenon remains unanſwered.

SECONDLY, Another extract from

Regnault in p. 23d endeavours to demonstrate, that the moon may receive reflected light from the earth; and thereby appear intire to an observer of a new moon, when she can no more receive light from the sun to give her the form of a circle, than in the case of an eclipse beforementioned. But if the sun's rays are reflected from the earth to the moon, they are also reflected from the moon to the earth: by which means the moon would heat the earth like a burning speculum, by means of the vallies and rocks with which she is said to abound. But no heat comes from the moon to the earth. " *In a clear winter's night, at the time of full moon, the image of that luminary being received directly on the speculum, produces a very bright focus, too vehement for any eye to endure. And yet the ball of a most exquisite thermometer, being applied to the centre of the same focus, affords not the least sign of heat or cold, but remains*

" *perfectly*

"*perfectly unmoved. Which appears the more* "wonderful, *as the rays reflected from the* "*moon's body upon the speculum were ori-* "*ginally directed by the sun: whose image,* "*as mentioned in the former experiments,* "*when received on a plain glass speculum,* "*and reflected directly therefrom upon* Vil-"lette's *concave one, produces a fire in it's* "*focus, almost as vehement, as if the rays* "*had been received immediately from the* "*sun itself.*" *Boerhaave*'s Chemistry, vol. 1. p. 268. This experiment proves, that the moon doth not reflect the rays of the sun to the earth.

THIRDLY, At the time of a new moon, the sun is often between the moon and us; and at the time of a full moon, the moon is often between us and the sun; contrary to the popular theory of the new and full moons. In the month of *February* last, at the time of the new moon, the moon was further south than the sun by many degrees, according to *White*'s ephemeris. Therefore the sun was

between the moon and us, and so the enlightened part, as it is called, was turned to us; but there appeared darkness instead of light, to us. Again, in the month of *June* last, at the time of the full moon, the moon was between the sun and us: for the moon's declination was 27°, 30′ north; and the sun's declination was no more than 23°, 17′.

FOURTHLY, Upon the supposition, that the moon is enlightened by the rays of the sun, she must shew contrary phases, at one and the same time, to different dwellers upon the earth. As may be demonstrated by an ephemeris, or indeed by any almanac. If when it is full moon, the sun be sometimes, though not always as we have seen, between the moon and *us*; yet to the inhabitants of the *south*, the moon will then stand between the sun and them; and *vice versa*, if they have the sun between them and the moon, we shall find the moon between the sun and us. So that if the moon's

moon's was a borrowed light from the ſun, it ſhould be full moon in one part of the earth, and new moon in the oppoſite part at the ſame time. But we may learn from the almanacs, or from obſervation, that it is full moon in all parts of the earth, at once, where the moon is viſible to the inhabitants: and the ſame may be ſaid of the new moon, as well as the full.

THAT the opinion concerning the opacity of the other planets, has no better foundation, is proved from the like experiments. I will give a caſe of one inferiour planet, which will ſerve for both; and of one ſuperiour planet, which will ſuffice for the reſt. When *venus* ſhew'd a very ſmall portion of light drawing towards her conjunction, in the month of *July*, the ſun was then between *venus* and us: for the ſun's declination at that time was more than one and twenty degrees north, and that of *venus* was ten degrees and half. Whence, upon *Copernican*

principles, she ought to have shewed us a round face instead of horns.

Jupiter was in conjunction with the sun in *June*: and about the beginning of *August*, I observed him with a telescope. He was very large, and bright, and round like a full moon, having his satellites about him very bright likewise. His declination was then about three and twenty degrees north; the declination of the sun being about seventeen degrees. So it is plain that *jupiter* was between the sun and us, and ought therefore to have shewn his dark face to us, if he had one: for the contrary hemisphere to what I saw was towards the sun, which they would call his enlightened hemisphere; therefore the other should have been the dark one. But from this phænomenon, it is certain that both hemispheres of the planet are light: or, which answers the purpose as well, that he does not borrow his light from the sun.

CHAP.

CHAP. VI.

The distances of the fixed stars refuted.

THE only proof alleged for the incredible distances of the fixed stars, is, that the telescope shews them as mere lucid points, without any sensible magnitude; as was observed from *Gravesande*, p. 28th. To which let me here subjoin the testimony of Dr. *Keill*, p. 40. "*Eæ* "*tam exiguæ apparent, si rite observentur,* "*ut veluti puncta tantum lucentia sine vi-* "*sibili quavis latitudine refulgeant: quo fit,* "*ut observationibus* nulla *earum mensura* "*deprehendi potest; cingit quidem flammea* "*omnia corpora in tenebris visa irradiatio* "*quædam seu capillitium, unde fit, ut cen-* "*ties et pluribus vicibus majores conspiciun-* "*tur quam si sublato capillitio viderentur.* "*Multum autem minuitur capillitium, si per* "*exiguum foramen acicula in charta factum* "*conspiciantur:*

conspiciantur: facilius vero et melius hoc incommodo medetur telescopia adhibenda, quæ radios illos adventitios auferunt, et stellas, ut mera puncta lucentia spectandas præbent."

It is astonishing, to find men of such eminence in the learned world assert, that the stars are diminished by telescopes. All astronomers acknowledge, that stars almost without number, are seen through telescopes, which are not be seen by the naked eye. What, do telescopes diminish objects to make them the better discerned? Are these stars made visible by being lessened, which were before invisible to the eye, only through their smallness? This is a strange kind of philosophy. In short it is plain from hence, that astronomers confess the magnifying power of a telescope, with respect to the smallest stars. And I can safely affirm, that stars barely visible to the naked eye, are rendered more conspicuous by a telescope. But for the larger stars, I have

 sometimes

ſometimes thought that the teleſcope magnified them, and at other times, it has appeared otherwiſe to me. So I have ſeen *mercury* alſo, with and without a teleſcope, ſo ſmall, that I could hardly diſtinguiſh, whether he exceeded the *ſtar capella* in magnitude or not.

My teleſcope is eighteen inches focal length, which magnifies about an hundred times, from what the Conſtructer of it ſays in one of his magazines. For he informs us, that a reflecting teleſcope of nine inches, which in theory ſhould magnify about ninety times, in fact magnifies but about fifty times; therefore one of eighteen inches magnifies twice as much, that is an hundred times. Through this teleſcope, I ſee very evidently, that the ſtars have ſenſible magnitudes, and that ſome are much larger than others. And from hence it is probable, that teleſcopes of two or three feet, will enlarge the ſtars of the firſt magnitude alſo very ſenſibly, although a ſhorter

as one does not. But why do I make this a probable case? We have the authority of Dr. *Keill* himself, that a telescope which magnifies an object two hundred times, *magnifies the star sirius*, from nearly one seventh part of a second to thirty seconds, which he makes to be the magnitude of mars in his largest form. "*Mirum est, quod* Ricciolus *sirii sive ca-* "*nis majoris stellam posuit sub angulo* 18" "*videri. Nam si tantus sirius nudo oculo* "*appareret, per telescopium visus quod du-* "*centies ampliat objecta quoad diametros, de-* "*bet ille sub angulo* 3600 *scrupolorum se-* "*cundorum seu angulo unius gradus videri;* "*unde et ejus discus solarem discum quater* "*superare videbitur: cum tamen certum est* "*telescopium illud exhibere sirium ut punc-* "*tum tantum lucens, et stella martis non* "*majorem. Mars autem cum nobis proxi-* "*mus atque maximus adest, sub angulo* 30 "*scrupulorum secundorum conspicitur. Unde* "*diameter* sirii *ducenties ampliata, non ma-* "*jor erit* 30 *scrupulis secundis; adeoque*

" *angulus ſub quo nudo oculo apparere de-*
" *bet, non major erit* $\frac{3}{20}$ *unius ſcrupuli ſe-*
" *cundi, ſeu novem ſcrupulis tertiis : hoc eſt,*
" ſirius *ſoli fere æqualis cernitur, ſi is tan-*
" *tum a nobis diſtaret quam* ſirius. " p. 41.
Here is an acknowledgement, from a chief of the *Copernican* philoſophers, that a ſtar is magnified greatly by a teleſcope, inſtead of being diminiſhed by it : contrary to what aſtronomers have taught concerning them, and contrary to what the *Savilian* profeſſor himſelf had delivered in common with other aſtronomers but juſt before, where he aſſerted with Dr. *Graveſande*, that it is their twinkling which makes them to appear under ſome magnitude, a magnitude above 100 times more than they would appear with, if they were ſeen without the twinkling, which he ſays is done by the teleſcope. The Doctor lays down this doctrine concerning all the ſtars in general, " *flam-*
" *mea omnia corpora,* " which is really very ſurprifing, when experience proves

so clearly, as I said before, that stars invisible to the eye in abundance, are so magnified, as to appear pretty large through the telescope; and others of the small visible ones are rendered much brighter and fuller by it. They appear also at greater distances from one another when they are viewed by the telescope, than to the naked eye, according to the effect which that instrument has upon terrestrial objects. There are two stars in the *hyades*, one of which is visibly beyond the other, so that the upper star is almost partially eclipsed, by the star which lies beneath. If you look at these through the telescope, you see them so far separated from one another, that upon your first observation, you cannot think them to be the same stars which you wanted to view, but will be apt to judge, that you have not pointed your instrument to the proper object. The same thing happens in another part of the heavens, namely, at the south-east

ſide of the *eagle*, where there are two ſtars nearly in the ſame poſition with thoſe which I have now ſpoken of. Alſo, if I point the teleſcope to the *pleiades* or ſeven ſtars, which, as every one knows, lie near together before the naked eye, they are not contained within what is called the field of view, ſo that I cannot ſee them all at once. Moreover, there are now many beſides ſeen amongſt them, which made it a difficulty to diſtinguiſh the ſtars called the *pleiades*, until at laſt I ſeparated them from the teleſcopial ſtars, by obſerving the exceſs of their magnitude above that of the others, which was diſtinguiſhable enough. Now notwithſtanding I cannot at once ſee the ſeven ſtars as they are called, though no more than ſix are to be ſeen by the eye alone, yet a large houſe is ſeen at once which is four or five miles diſtant, when at the ſame time, the *pleiades* do not ſeem to the eye to take up more ſpace than the window of ſuch an houſe. Who

would have thought the effect of a perspective upon the stars should have been so little known, after it has been so long invented, and after such repeated uses of it by so many learned and ingenious men at home and abroad? For it is certainly more becoming the character of a philosopher, to be ignorant of many truths, than to propagate falshoods. If it had been therefore known to philosophers, that the power of the telescope is not confined to terrestrial objects, but reaches also to the stars of heaven, we may conclude they would not have maintained the contrary to support their hypothesis.

ANOTHER instance which I am going to mention, brings with it also the appearance of a probability, that the use of the telescope amongst celestial objects, was less thought of by eminent astronomers, than might have been expected. Who taking upon them to answer an unanswerable objection, have amused themselves with such kind of reasoning as

the teleſcope diſcovers to have no force. They had ſeen an objection againſt the ſtarry diſtance upon their own principles, that ſince by the ſuppoſed motion of the earth we draw ſo much nearer to ſome ſtars when we are upon one extremity of the earth's orbit, than at the oppoſite end of it's diameter; they muſt needs appear larger and further apart from one another, when we ſee them from that end of the diameter of the earth's orbit which is next to theſe ſtars, than when we look at the ſame ſtars from the other extremity of the diameter which is moſt remote from them. That there ſhould be this alteration in the magnitudes and intervals between the ſtars, upon ſuch an immenſe alteration of diſtance by the obſerver, ſenſible to the eye, is very reaſonable to imagine; when the diſtance from the earth to the ſun has been computed 80 millions of miles, which is but half of the diameter of the annual orbit; ſo that we are ſuppoſed

to

to be 160 millions of miles nearer to some of the stars in winter, for instance, than in summer. Yet astronomers boldly deny that there would be any difference in the magnitudes of the stars, or in the intervals between two stars, sensible to the eye by such an approximation. Some readers may be ready to suspect a false accusation here, in the charge of such improbabilities on astronomical writers. Take then the authority of the very eminent Dr. *Keill* in his own words extracted from the 38th and 39th pages of his astronomy. " *Quamvis tanta sit tel-*
" *luris a sole distantia, ut ex hoc spectata*
" *tellus, quasi ut minutum aliquod punctum*
" *videtur, ea tamen distantia, ad stellarum*
" *fixarum distantiam comparata, tam exigua*
" *habenda est, ut etiam si orbita in qua*
" *diximus terram circa solem deferri e stel-*
" *lis fixis conspiciatur, ea etiam ut punctum*
" *apparebit, anguluſque sub quo orbitæ dia-*
" *meter ex fixa videtur tam exiguus est, ut*
" *ab astronomis acutissimis vix observari hac-*

" *tenus*

" *tenus potuit.* —— *Hinc sequitur, quod* " *etiamsi tellus ad aliquas stellas* propius " *uno anni tempore accedat quam in opposi-* " *to, idque* intervallo diametri orbitæ suæ, " non *tamen stellæ illæ* majores *apparebunt*, " *neque* ulla fiet apparentis intervalli in- " ter duas quasvis stellas sensibilis mu- " tatio *propter diversas spectatoris positio-* " *nes.* " The telescope proves this reasoning to be false. For as it is a plain matter of fact, that the stars are magnified, and enlarged in their mutual distances, by that instrument, which is demonstrated experimentally; it is most certain, that an approach towards the stars would have the same effect. " *Si tele-* " *scopia adhibeantur, quæ objectorum diame-* " *tros centies vel etiam ducenties augeant;* " *ea apparentias exhibebunt plane similis iis,* " *quæ ex distantia centies vel ducenties mi-* " *nore conspicerentur* ." *Keill.* p. 10.

FROM what has been here advanced concerning the effect of a perspective when used for observing the stars, the

quiescence

stationary of the earth is confirmed, the diameter of the supposed orbit being annihilated, see p. 37. And the hypothesis of the amazing distances of the stars is intirely overturned: distances so immensely great as to exceed the degrees of credibility. For *Regnault* tells us, "*the most skilful* "*astronomers are inclined to place the dog* "*star at more than* 40 *thousand times* 33 "*millions of leagues from hence.*" p. 228. Which amounts to millions of millions of miles, and agrees with what Dr. *Harris* says of the stars: "*I believe we are* "*not much out of our computation, when* "*we conclude, that a ray of light cannot* "*come from thence in less than* 6 *months* "*time, nor a cannon ball in* 50000 *years.*" p. 82. In the next page the Dr. informs us concerning the motion of light, that "*it runs after the rate of above* 10 *mi-* "*lions of miles in a minute.*" The wisdom of the wise forsakes them, when they neglect the account of the creation revealed by the AUTHOR of nature, and set

themselves up as creators of new worlds.

THE *Copernican* system having been for many ages generally esteemed as true, I can hardly err in multiplying proofs against prepossession, to make it incontestably evident, that the subtlety of philosophical arguments for new systems of the world, totally different from the system communicated by the inspiration of the HOLY GHOST, amounts at last to nothing but futility and vanity. On this account, I shall hope to be excused, for using yet another argument, after all that has been already said, against the immense distances of the stars: whereby without the assistance of a telescope, it is demonstrated to every man, that the distances which astronomers have given to the stars is naturally impossible, upon their own principles. They admit, that the celestial ecliptic is inclined to the earth's axis; and that one part of this vast orb lies in the southern hemisphere, and the other part in the hemisphere of

the north the place of our dwellings. The earth is a mere point compared to the prodigious diameter of this orb; therefore the starry ecliptic projects many hundred millions, thousand millions, and millions of millions of miles from the poles of the earth: the south part of the ecliptic projects to this infinite distance beyond the south pole of the earth, and the other part of the ecliptic elevated above our hemisphere, projects over and beyond our heads, many millions of miles, even infinitely in a manner beyond our pole of the earth. In this situation the stars to the north of the ecliptic, the seven stars for instance, being supposed far north from us must appear in the north to us when they are upon our meridian: but no man is weak enough to turn himself to the north for observing them, knowing that they do not come far enough towards the north to be vertical to us. Therefore they cannot possibly extend beyond the earth at

 all

all to the northward, not reaching our zenith who are many degrees short of the pole of the earth.

It is now acknowledged, as was shewn from Dr. *Keill*, p. 27th, that there is no parallax of the stars, yet so lately as in the days of Mr. *Whiston*, that ingenious gentleman had spirit enough to defend the contrary opinion, and at the end of his conclusion to put *Q. E. D.* as if the parallax were actually demonstrated. He builds his assurance upon *Hooke*'s and *Flamsteed*'s observations: the latter of whom, as Mr. *Whiston* informs us, observed the fixed stars to find their parallax for seven whole years, "*per septennium integrum.*" The result of which was, that there seemed to him an appearance of a parallax about $\frac{3}{4}$ of a minute; nevertheless, he suspected that appearance might arise from another cause. But as the certainty of the parallax would make a certain proof of the earth's motion; Mr. *Whiston*'s prejudice in favour of that o-

pinion led him too hastily to his conclusion, that the great pains which *Copernicans* had taken to settle this point, had at last brought them to a decisive victory. " *Quanta tum cura et studio in hoc* " *negotium incubuerunt* Copernicani *nemo* " *dubitaverit qui ex hac annua parallaxi,* " modo reperiri possit, *systema suum* Py- " thagoricum, *sive annuum telluris motum,* " *de quo tam acriter disputatum fuit, non* " *persuaderi modo, sed et certo demonstrari* " *posse agnoverit: neque aliud ad stabilien-* " *dum istum motum, et ad redarguendum et* " *pervincendum adversariorum pervicacissimos* " *desiderari, quam ut fixarum parallaxis se-* " *cundum varium in orbe magno telluris si-* " *tum, sentiri possit. Quam quidem paral-* " *laxin* Hookii *et* Flamsteedii *nostratium* " *diligentia tandem aliquando in lucem pro-* " *traxit: atque eo pacto systema mundi* Co- " pernicanum, *sive annuum telluris motum,* " *non solum ab omni scrupulo liberavit, sed* " *et omni praeter dubia centum et demon-* " *strata dedit.* " Praelect. Astr. p. 94.

Surely

Surely here was no cause of triumph, for a star's variation of it's position about 45 seconds, when, if the observations could be made without error, which has been judged impracticable, astronomers acknowledge a variation from a small change of the equinoctial points, to which the accurate observer himself suspected it might be attributed. " *Neque diffitetur* Flamsteedius " *suspicionem oriri posse, exiguam hanc axis* " *telluris nutationem posse quadantenus appa-* " *rentem hanc stellæ polaris (saltem, si non* " *et reliquarum,) mutationem efficere,* sine " ulla interea vera earum parallaxi. " p. 39. This small difference in the situation of a star, as supposed to be observed from opposite points of the earth's vast orbit, is about a fortieth part of the sun's apparent diameter; which diameter is little more than 2 inches: then the parallax amounts to the twentieth part of an inch, which is to be deducted from 160 millions of miles. But if the parallax of the annual orbit had a real existence,

tence, it would be sensibly large, as is proved from the phænomenon lately mentioned; how that two stars having scarcely any space between them discernible to the eye, are set at a considerable distance from each other by the telescope. For what is an approach towards the stars by the telescope, compared with an approach of 160 millions of miles, made by the earth in her journeying from one point of her orbit to the opposite point! If we should admit what is inadmissible, that the telescope gives a clear representation of objects and the spaces between two objects, at the distance of 100 miles beyond the place where the eye unassisted can barely perceive a space; then it follows, that if we advance 100 miles towards the double stars which I spake of, we should see them at the same distance from one another as the telescope now presents them, that is, at a very sensible distance, about thirty times greater than the parallax, as appears by observation.

vation. " *His telescopiis altius in cœlum in-*
" *vehimur, et jovi et saturno reliquisque er-*
" *rantibus, quin cometis quoque et fixis tam*
" *prope admovemur, ita ut tam longi itine-*
" *ris pars tantum centesima vel etiam ducen-*
" *tesima nobis restet.* " *Keill.* p. 11. From the sense of this passage it is plainly enough perceived to be an established rule amongst astronomers, that the effect of a telescope is the same upon the stars as an actual approach towards them. Wherefore an approach of 100 miles or less will increase the distance between two stars as the telescope increases it, thirty times more than the annual parallax. And from hence it is demonstrated, that an approach of a few miles would make a sensible difference in the space between two stars. What a difference would arise then from an approach of many hundreds of miles? Yet we perceive no sensible difference by a supposed approach of many thousands, and many millions of miles. Whereby we have an incontestable proof,

that

that there is no such approach made towards a star, and consequently also, that there is not an annual motion of the earth. See before, p. 37.

CHAP. VII.

The magnitudes of the stars disproved.

THE stars are said to be in their dimensions neither much greater nor less than the sun; and astronomers teach, that they are to be esteemed as suns. "*Immota itaque cœli astra sunt corpora sua* "*natura ignea, instar solis nostri, quæ huic* "*nec magnitudini cedunt, nec multum supe-* "*rant; adeoque pro totidem solibus haberi* "*possunt. Concipiendum porro est, soles hos* "*non in una eademque superficie hærere, sed* "*per immensa mundi spatia, undique disse-* "*minari, et longissimis intervallis a se in-* "*vicem distare; ita ut tantum inter duos*

" *quoslibet soles proximos, interjiceat spatium* " *quantum ad minimum inter solem nostrum* " *et* sirium *porrigitur. Hinc, spectator qui* " *alicui soli propius adest, illum tantum ut* " *solem conspiciet, et reliquos omnes soles ut* " *micantia astra, in cœlo seu firmamento pro-* " *prio inhærentia videbit.* " *Keill.* p. 42. The cause of their apparent unequal magnitudes, as they are seen by us, is owing to their different distances from us and from one another. " *Quod fixæ dispari in-* " *ter se magnitudine appareant inde evenit,* " *quod non omnes pari a nobis distent in-* " *tervallo, sed quæ propius absunt reliquis* " *tum magnitudine tum luce præcellere vi-* " *dentur; illæ interea quæ longius distant* " *minore et mole et splendore conspiciuntur.* " p. 50. Since the stars have nearly the dimensions of the sun, by knowing the magnitude of this we discover the magnitudes of these. The sun's diameter, according to Mr. *Whiston*, is 763460 english miles. p. 85. " *According to M. Cas-* " *sini, the globe of the sun is a million of* " *times*

"*times bigger than the earth.*" *Reg.* p. 199. Computing the earth's diameter at 7000 miles only, we find M. *Cassini*'s sun will be 7000 millions of miles bigger than Mr. *Whiston*'s. Which has the look of a different sun from the other that is so much less. Dr. *Keill* makes the sun's diameter 146 times greater than the diameter of the earth: thence the number of miles contained in the sun's diameter will be 1022000. "*Solis diameter e-*
"*rit* 146 *vicibus major telluris diametro.*" p. 442. By comparing these calculations together, a difference of 250 thousand miles and upwards arises, between the two suns of the *Lucasian* professor and the *Savilian* professor, and a difference of many millions of miles, between M. *Cassini*'s sun and the suns of the professors. They ought to have made their accounts agree better, if they would persuade us that there is any thing like a criterion, whereby the diameter may be judged of with any tolerable degree of probability.

probability. But that there is neither probability nor possibility of the stars having these vast dimensions, appeared sufficiently before, if no such thing as prejudice could be apprehended; when the distances attributed to the stars were disproved, for thereby the magnitudes are disproved also; a proportion being by all acknowledged between the magnitudes and distances: whence if the distances of the stars are in truth as nothing, compared with their imaginary distances, their real magnitudes will be likewise as nothing compared to their imaginary magnitudes.

SPECULATIVE proofs ought not to pass where actual experiments may be made: wherefore I was resolved to find out, if it were possible for me, the dimensions of a star in parts of an inch, which might satisfy me with respect to the disputes concerning their proportions in minutes: as Dr. *Keill* reproves *Riccioli*, for assigning to the star *sirius* an angle of

of 18″, when he says it is seen under an angle of 9‴ only. To attain my purpose, I took the following method. I had several small human hairs drawn over a hole in a thin plate of lead, which I placed as a micrometer in the eye-piece of my telescope, between the image-glass and eye-glass; in which position the hairs were magnified by one glass only. The hairs lay at different distances from one another, some almost touching, as they seemed to the naked eye, and others somewhat further apart. I chose the morning light for an observation of *Sirius*, by which the hairs were seen perfectly distinct, without the trouble of a candle-light. Some of the spaces between two hairs were too large for the star to fill, which one would have hardly suspected, for the distance was but little which exceeded the star's diameter. But it was presently evident, that there was a determinable magnitude, although the contrary had been asserted. For letting the

telescope rest, I observed the star as it passed over the hairs; and could very distinctly perceive his approach to the hairs, and passage over them; during which passage, a part of the star was seen on one side of the hair, and a part on the other. Having gained this satisfaction, I brought the star upon two hairs placed nearest together, the space between these did not quite contain or define him. This space I took for the measure of his magnitude, which I wanted to determine in parts of an inch. To effect this, having taken the plate with the hairs out of it's place in the telescope, I laid it upon white paper, for viewing it conveniently with a magnifying glass. I then took close-pinching plyers, which being springy were opened by a small needle to the exact distance of the hairs. As the needle kept the cheeks of the plyers in the same position, I compared them with a small division of *Gunter*'s scale on a two-foot rule, whereby it appeared, that

this

this one division upon the scale contained three of the small measures of the plyers or hairs. And that division which was equal to the three small measures, was half a tenth, or a twentieth part of an inch. These measures were adjusted with care, by a magnifying glass, so that every part was seen very distinctly, and I believe the measure to be pretty exact. The diameter of the star was therefore a twentieth part of an inch, if the glass of the telesope only triples the diameter of an object. That I might be certain of it's magnifying power, which I guessed to be something less than opticians make it, I viewed a small letter in a printed page through the magnifying glass of the perspective, looking at a large capital with the naked eye, which seemed equal to the small one magnified, and found the white part of the diameter of the small letter to be thrice contained in the white diameter of the capital. From hence I judged the diameter

meter of the ſtar to be three times as extenſive as the meaſured ſpace between the hairs unmagnified, that is one twentieth part of an inch.

I hinted a ſuſpicion that the glaſs is ſaid to magnify rather more than it does, in theory. "*The ſurfaces of objects are* "*magnified* 36, 49, *or* 64 *times by a* "*lens of one inch focal diſtance.*" that is "6, 7, *or* 8 *times in length and breadth.*" Optical Eſſays p. 44. The diſtance between the lens and hairs was one inch and 3 quarters. And therefore by the rule it ought to magnify nearly 4 times, which I concluded to be only 3 times.

SMALL as this meaſure may be thought by the unexperienced, it is conſiderable amongſt celeſtial bodies. Comparing *venus* with *ſirius*, I diſcovered that *venus* took up leſs ſpace between the hairs than *ſirius* did. But it muſt be noted, that it was but the ſemidiameter of the planet which was meaſured, as *venus* was then almoſt in the form of an half-

moon.

moon. The sun's diameter also taken the same way, was no more than 7 tenths of an inch, which being afterwards trebled in passing through the lens became 2 inches and one tenth part of an inch. Whence *sirius* was found in diameter almost a fortieth part of the sun's diameter; which Sir *Isaac Newton* makes much the same by a prism in a dark room. "*The breadth of this image answered to* "*the sun's diameter, and was about two* "*inches and the eighth part of an inch in-* "*cluding the penumbra.*" Optics p. 23. At other times the sun's diameter may be somewhat more or less, for it is variable, as is that of the moon also. "*It* "*scarcely happens in an age in two eclipses,* "*that the apparent diameters of the sun* "*and moon are the same,*" *Bion*'s uses of Math. instrum. p. 165. The breadth of the star obtained in parts of an inch may be known likewise in parts of a degree, as it may be now compared with the sun's diameter in inches and parts,

which

which is known in the parts of a degree, "*about half a degree is the sun's apparent* "*diameter.*" ibid. If then the sun's apparent diameter of about two inches be half a degree or 30 minutes, the apparent diameter of *sirius* being about a fortieth part of the sun's diameter will be about three fourths of a minute or 45 seconds, which is as much as the imagined parallax of the annual orbit. It is not to be wondered at if *sirius* exceeded *mars*, as the planet was diminished very considerably from his greatest magnitude when I measured him by the hairs; since Dr. *Keill* has told us, which was before taken notice of in page 50, that *sirius* is about the size of *mars* when he is largest. But *mars*'s greatest apparent diameter according to *Tycho*, *Kepler*, and other eminent astronomers, exceeds *jupiter*'s apparent diameter, as may be seen in *Wolfius*, Elem. Math. tom. 2. p. 486. And *jupiter* is acknowledged to have a measurable diameter, by which the revolu-

tions of his satellites are determined according to *Kepler*'s rule, and Sir *Isaac Newton*'s principle of gravitation: from whence again it appears, that astronomers contradict themselves, when they say the stars have no sensible magnitude viewed by a telescope.

THERE was no necessity for this nicety in determining the magnitude of the star. It had been sufficient for overthrowing the hypothesis of the stars having no magnitude, to observe that the star was *divided* by the hair very sensibly and clearly, in it's passage over it. For to prove the stars to be points, astronomers are wont to allege, that the *parts* of a star are not discernable, when another body is applied to it and eclipses it; when the moon or any other planet passes over it, the star is said to be instantaneously eclipsed, and to emerge instantaneously. "*Now that the fixed stars,* "*by reason of their immense distance, appear* "*like points, unless so far as their light is* "*dilated*

" *dilated by refraction, may appear from* " *hence; that when the moon passes over* " *them and eclipses them their light vanishes,* " *not gradually like that of the planets, but* " *all at once; and in the end of the eclipse* " *it returns into sight all at once, or cer-* " *tainly in less time than the second of a* " *minute; the refraction of the moon's at-* " *mosphere a little protracting the time in* " *which the light of the star first vanishes,* " *and afterwards returns into sight.*" Optics, p. 88. If there be not in this quotation a full acknowledgment, that a star has sensible dimensions, it is something very like it, although imputed to the refraction of the moon's atmosphere; which she is not permitted to enjoy by universal consent amongst philosophers. " *But* " *if the cavities of the moon have their* " *internal surface, solid and without water,* " *the moon ought then to have no atmo-* " *sphere.* Eudox. *Accordingly she has none,* " *at least sensible. If the moon had a sensi-* " *ble atmosphere, we should perceive some* " *change*

" *change in a fixed star, or planet, that*
" *approached too near the discus of the moon,*
" *and visibly touched it. The passage of the*
" *rays thro' this atmosphere, and their re-*
" *fraction would change the situation, splen-*
" *dour or colour of the stars. Now, the*
" *most attentive observators of those kind*
" *of changes have remarked none of them*
" *in this case. The moon eclipsed* venus *the*
" 28*th of* June 1725; —— *and neither*
" *in the immersion nor emersion did they see*
" *any change, in it's motion or figure, or*
" *colour.* —— *It is true, that some skilful*
" *observers saw* venus *in the same eclipse*
" *suddenly change colour upon immersion and*
" *emersion. But ought not this change to be*
" *referred to the perspective glasses?* —— *In short, make a fixed star enter into a*
" *perspective, : the* brim *of the star which*
" *is toward the axis of the perspective, be-*
" *comes red, and the* other *blue; but the*
" *red and blue are defaced when the star*
" *is upon the axis, or in the centre of the*
" *telescope.* ". *Regn.* p. 173, 174. The in-

genious

genious reader will not expect any remarks to be made for him, from these quotations.

BEFORE we yet depart from amongst the fixed stars, there is another point which merits attention. Astronomers inform us concerning the stars, that "*it is only their twinkling which makes* "*them appear to have any sensible magni-* "*tude.*" p. 28. And that telescopes take away the rays issuing from the stars and causing the twinkling to the eye; "*ra-* "*dios illos adventitios auferunt, et stellas* "*ut mera puncta lucentia spectandas præ-* "*bent.*" p. 48. I am sure that I see the rays streaming from the stars, when I look at them with my telescope, as evidently as I can see any circumstance whatsoever of the heavenly bodies acknowledged to be objects of telescopical observation. As for the star which is called *capella*, I have known it hid from my observation through my telescope, in a body of light, but *not* "*without any* "*trembling*

" *trembling of the whole.* " Optics, p. 98. From this body of light were darted successive flashes, quick as the twinkling of the eye. At another time, it appeared destitute of this adventitious light, so far as to have only rays like other stars: and again the rays increased and flashed as before. The observation of which phænomenon by a good reflecting telescope, must convince the most sceptical, of the errors which astronomers have fallen into, with respect to the distances and magnitudes of the fixed stars, and consequently, of the distances and magnitudes of the planets also: which points however are next to be particularly discussed.

CHAP. VIII.

The distances of the planets disproved.

THE distances of the planets are not better supported than other parts of

of the ſyſtem, which appeared, after examination, to be hypotheſes. Aſtronomers have laboured much to find their parallaxes, which would determine the diſtances of the planets; but they have been forced to confeſs at laſt, that they cannot diſcover what they have ſo diligently ſought after. They will have it indeed, that the moon has a ſenſible parallax, but no other planet beſides. "*There is only the parallax of the moon,* "*which can be determined by obſervations.* "*The diſtance of the reſt of the bodies in* "*the planetary ſyſtem is too great to be* "*compared with the ſemidiameter of the* "*earth. And the parallax depends upon the* "*ratio, which the ſemidiameter of the earth* "*has to the diſtance of a planet: therefore* "*even the parallax of mars in oppoſition* "*with the ſun, is too ſmall for the niceſt* "*obſervations.*" *Graveſande*, p. 187.

ALTHOUGH they ſeem confident, that the moon has an obſervable parallax; yet even here, their arguments will

be

be found upon examination to be raised upon hypotheses also. For, first of all, they suppose the stars at an immense distance from the earth, which has appeared an erroneous opinion. And further they suppose for the origin of all their deductions, that a line drawn from the moon to the earth, to constitute their horizontal parallax, will make a right angle with the diameter of the earth: and yet they confess the moon is so raised by refraction, that she may appear above the horizon when her true place in the heavens is below it; in which case, a line drawn from the extremity of the earth's diameter to the moon, will necessarily make an acute angle, not a right one. And to shorten the argument, they further confess, that even with respect to the moon, they cannot properly distinguish between the parallax and refraction. " *Si inveniantur fixarum* " *refractiones, dabuntur etiam, solis, lunæ-* " *que, et planetarum omnium refractiones:*

" *et*

" *et per observationes, facilius investigatur*
" *fixæ alicujus refractio, quam solis, et lu-*
" *næ; quippe* horum siderum non satis
" accurate notæ parallaxes, *investigationem*
" *refractionum dubiam reddunt, dum* incerta
" sit quanta loci mutatio parallaxi, quan-
" ta refractioni debetur. *At stellæ fixæ nulli*
" *parallaxi obnoxiæ sunt, et tota loci varia-*
" *tio a refractione pendet.*" *Keill.* p. 312.
The Doctor confesses, that the parallax of the moon is not accurately known, and that what change is due to the refraction, or what to the parallax, is also unknown. " *The parallax depends upon the*
" *ratio, which the semidiameter of the earth*
" *has to the distance of a planet.*" p. 81.
And the least distances of the planets from the earth being many millions of miles, according to the hypothesis; " *the*
" *ratio which the semidiameter of the earth*
" *has to the least distance of a planet*" is as unity to thousands. Hence, if a man could see a planet from the earth's centre or equator by one observation, and

could also see the same planet from either of the poles by another observation: the diameter of the planet would not be increased a thousandth part by the approximation, which is not perceivable. But the moon being placed at the distance of only 60 semidiameters from the earth; if the moon could be seen from the earth's centre, and also from it's surface; this difference of distance by the two observations, or the earth's semidiameter, would bring the observer nearer by a 60th part of the distance: which approximation would increase the apparent diameter of the moon a 60th part, and would be sensible. By the refraction, of nature and art, the moon is brought in a manner home to the eye, as will be very evident to an attentive observer, her distance from the eye being apparently less, than objects appear through the telescope which are in the neighbourhood of the observer. So we may turn the weapons of astronomers against themselves, and

 say,

ſay, as the ratio of the ſemidiameter of the earth is to the diſtance of the moon from the earth as thouſands to unity; a retreat from the pole to the centre of the earth, *without altering the circumſtances of refraction*; would make ſuch a change or parallax in the moon's diameter, as would bring it to a teleſcopial ſtar, or rather an inviſible point: *which difference of diameter*, as it has been never known or ſuggeſted to exiſt, we muſt conclude there is *no ſuch difference of diſtance*: and ſo the arguments for the parallax are refuted, like the other philoſophical arguments, by facts and experiments.

WHAT was given as a proof of the moon's diſtance, from a computation of the dimenſions of her ſhadow, in p. 27th, is manifeſtly an hypotheſis: for it has been fully proved, that the moon has no ſhadow, not ſhining by a borrowed light from the ſun, as was ſuppoſed.

MOREOVER, a perſpective has the ſame effect in overturning the hypothe-

sis of the planetarian distances, as it produced before, when applied to the hypothesis of an almost infinite distance of the starry sphere. As the distances of the stars were, in a manner, annihilated thereby; so it may be clearly proved by the same instrument, that the distances of the planets are likewise imaginary.

THE mean distance of *venus* from the sun is said to be sixty millions of miles. p. 10. The sun's distance from the earth is supposed 70 or 80 millions of miles. p. 8. Hence, the distance of *venus* from the earth, will be 20 millions of miles when she is in conjunction with the earth, or in her nearest position to it. When she is on the opposite side of the sun, her distance from the earth, is about sixty and eighty or an hundred and forty millions of miles. The difference between her least and greatest distance from the earth, is therefore 120 millions of miles. Yet although we are supposed to be so much nearer the planet in one season, than in another; we

never

never ſee *venus* horned, as the moon is ſeen in her increaſe or decreaſe: which the teleſcope ſhews, every jot as diſtinctly and clearly, as the eye ſees the phaſes of the moon. It is obvious as was remarked, p. 64, that the teleſcope doth not aſſiſt the eye examining an object at a great diſtance, as much as an approach of 100 miles towards the object. I have reaſon to think, that the magnifying power of my teleſcope doth not exceed 10 miles, I mean ſo as to ſhew an object diſtinctly, as it ſhews the phaſes of *venus* with the utmoſt clearneſs. From whence it follows, that the *apparent* place of *venus* hardly exceeds 10 miles, ſo far does it come ſhort of more than ten times ten millions of miles.

THE ſame reaſoning may be applied to *jupiter's ſatellites*, never viſible to the naked eye, but ſeen moſt diſtinctly and clearly by the teleſcope, as I have experienced, when jupiter was almoſt at his ſuppoſed greateſt diſtance from the

earth.

earth. This planet is judged to be 424 millions of miles distant from the sun. See p. 11. Add to this the sun's distance from the earth 80 millions of miles; his distance from us must then be above 500 millions of miles. The telescope which shews the *satellites* of this planet, must have the effect of an actual approach of so many millions of miles towards them, if they are really at their assigned distance from us; otherwise it could not render them perceptible to us. But it has appeared, that the telescope's power doth not extend 100 miles: therefore the apparent place of *jupiter's satellites* is not 100 miles from us, which philosophers would have us believe to be upwards of 500 millions of miles.

THE philosophical error concerning the immense distances of the planets from us, appears yet more enormous when we apply the argument to *saturn's ring*. Saturn is placed at the distance of 777 millions of miles from the sun. p. 11.

This

This is his mean distance. To which if we add his eccentricity, and the sun's distance from the earth, saturn's greatest distance will be found a great deal beyond 900 millions of miles. The telescope shews this planet's *ring* as distinctly, at his greatest distance, as it shews the phases of venus, and satellites of jupiter, and that is as distinctly as any thing is seen by the naked eye, when it is within the proper limits for the eye to observe and judge of it. But since it has been demonstrated, that the telescope cannot command lesser distances, it is very certain, that it's power doth not extend to greater and more incomprehensible distances: therefore it is very certain, that the distances have no existence in nature.

THE perspective proving that an approach of 100 miles or indeed of 10 miles towards these three planets *venus*, *jupiter*, and *saturn*, would shew the *moon-like phases* of the first, the *satellites* of the

the second, and the *ring* of the third planet; and experience proving, that the eye alone never sees those phænomena: we are infallibly assured, that we do not make the approaches of 100 miles, or of 10 miles, towards either of these planets. From whence arises demonstrative proof again, that the earth doth not approach towards the planets, or that there is not an annual motion of the earth. See pages 37 and 66.

CHAP. IX.

The magnitudes of the planets disproved.

THE weakness of human wisdom shews it self increasing rather than diminishing to our view, as we continue our examination of the philosophical system of nature. Philosophers are as little agreed about the magnitudes of the planets,

planets, as about the dimensions of the sun; concerning which I shewed in p. 68, that there was a great diversity of opinion amongst the most eminent astronomers. The like diversity obtains concerning the diameters of the planets, as appears by the following table taken from *Wolfius*, tom. 2. p. 486.

		Minim.		Med.		Maxim.	
Albategnius	♄	1′	29″	1′	44″	2′	5″
Tycho		1	34	1	50	2	12
Keplerus		0	21	0	25	0	38
Ricciolus		0	46	0	57	1	12
Hevelius		0	14	0	16	0	19
Albategnius	♃	2	9	2	36	3	18
Tycho		2	14	2	45	3	59
Keplerus		0	30	0	38	0	50
Ricciolus		0	38	0	49	1	8
Hevelius		0	14	0	18	0	24

See Bonycastle p. 91

		Minim.		Med.		Maxim.	
Albategnius	♃	0′	54″	1′	34″	6′	10″
Tycho		0	57	1	40	6	46
Keplerus		0	54	1	34	6	30
Ricciolus		0	10	0	22	1	32
Hevelius		0	2	0	5	0	20
Albategnius	♀	1	49	3	8	16	42
Tycho		1	52	3	15	4	40
Keplerus		1	2	1	48	7	6
Ricciolus		0	33	1	4	4	8
Hevelius		0	9	0	16	1	5
Albategnius	☿	1	27	2	5	3	41
Tycho		1	29	2	10	3	57
Ricciolus		0	9	0	13	0	25
Hevelius		0	4	0	6	0	11

AFTER the author had given us this table from *Hevelius*, he adds, that *Huygens* had found the least diameters of

three

three planets, *saturn*, *jupiter*, and *venus*, most accurately. "Christianus Hugenius "*methodo exquisitiore diametros planetarum* "*apparentes investigans deprehendit diame-* "*trum minimam* saturni 30″, *annuli ejus* "1′ 8″, jovis 1′ 4″, martis 30″, vene- "ris 1′ 25″. *Ex his observationes in sa-* "turno, jove, *et* venere *accuratissimas ju-* "*dicat.*" The reader will observe in the table, a great difference of dimensions attributed to the planets, by different astronomers. And *Huygens* by his method makes the least diameter of *venus* almost 10 times as much as *Hevelius* does. What can be depended upon in such an uncertainty of opinion, amongst men of the first character in mathematical learning? Is it not apparent from hence, that they have none of them any certain knowledge in those matters, although they propose them as mathematical subjects capable of demonstration?

BUT if this difference amongst the great names in philosophy should not con-

since every reader, that they have not as yet made a science of astronomy; my next argument however carries demonstration with it, that they have not shewn any skill or judgment, in what they have written concerning the magnitudes of the planets. The astronomical teaching is, that the superiour planets have greater apparent dimensions when they are in opposition, than when they are in conjunction with the sun: and that the inferiour planets appear greater as their light is diminished, than when it is increased. This is taught as matter of fact, ibid. p. 484. "*Imprimis vero notabile est,* "*planetas superiores multo majores appare-* "*re, si fuerint acronychii seu in* oppositio-"ne cum sole, *quam prope conjunctionem* "*cum eodem; planetas vero inferiores ma-* "*jores videri si lumine fuerint* diminuti, "*quam ubi* aucti *extiterint.*" From hence, as from a real fact, an inference is made, that the superiour planets are *nearer the earth* in their opposition with the sun, than

than about their conjunction. "*Planetæ* "*superiores sunt terræ propiores in oppos-* "*tione cum sole, quam circa conjunctionem.*" ibid. And another inference is drawn from the same observation, so called, that the inferiour planets are *nearer to the earth* if they are diminished in light, than if they are increased. "*Planetæ inferiores ter-* "*ræ propiores sunt si lumine diminuti, quam* "*si aucti fuerint.*" Moreover, the sun is at it's supposed greatest distance from the earth when it is in the sign *cancer*, and at it's least distance in *capricorn.* "*Maxi-* "*ma adeo solis a terra distantia hodie in* "cancro *est*, *minima in* capricorno." p. 485. From these preliminaries, we are enabled to form a judgment of the rules which astronomers follow, in determining the dimensions of the planets. On the 19th of *June* last, *jupiter* was in conjunction with the sun, when they were both entering, as it may be said, into *cancer*, the place of their *apogea* or greatest distance: for the sun was got thither

on

on the 21st day of the month, where *jupiter* also arrived on the 25th. According to the preliminaries, *jupiter* ought at his appearance after his conjunction, to have shewn himself in miniature; but on the contrary, his magnitude was surprizingly increased, far exceeding the dimensions under which I had seen him at any time before.

SATURN also was inlarged in the same manner by his conjunction, in the sign *taurus*, not very far from the place of the sun's greatest philosophical distance: who gradually diminished afterwards, and did not shew his ring so large as at the beginning of my observing him, yet distinctly.

I observed of *mars* also, that when I began first to view him, which was a good while after his conjunction, he was abundantly larger than he appeared afterwards, dwindling as he retreated from the sun, as saturn and jupiter did.

FROM these experiments it is demonstrably

ſtrably certain, that the ſuperiour planets are largeſt in their conjunction; although aſtronomers teach, that they are ſmalleſt at that ſeaſon; and that the increaſe of their diameters, is not owing to their being at that time nearer the earth, and at another time further from the earth, which I have before proved in theſe papers to be a mere chimæra or creature of fancy; when they were, according to the allotments of philoſophers themſelves, rather at their greateſt than leaſt diſtance from the earth, at the time that they had their greateſt dimenſions.

WHAT has been here delivered concerning the ſuperiour planets, is equally applicable to the inferiour. For the dimenſions of *venus* exceeded the proportions of jupiter and ſaturn by much; and her conjunction was in *leo*, in the month of *Auguſt* laſt, the very next ſign to *cancer*, which is ſaid to exhibit the ſun at the greateſt diſtance from the earth. Aſtronomers have been therefore great-

ly

ly mistaken, in imputing the increase of her diameter to an imaginary return towards the earth, after a long journey from it; which journey was never undertaken. And it is either a palpable error, or unphilosophical inattention, to speak of this planet as inlarging her dimensions upon the *diminution* of her light, which happens on the contrary when her light is *increasing*.

It is not my purpose to account for the various phænomena in the true system of nature, until I come in my next volume to unfold the doctrine of *Moses* the prince of philosophers. Yet since I have advanced so far as to point out the times of the greatest magnitudes of the planets, the reader will perhaps expect, that I should in this place account for that increase of magnitude; as I have rejected the philosophical reasons, which have been given in vain to explain the matter.

Now a very good reason may be given,

given, why the ſun's intenſe heat upon a planet brought near it, ſhould increaſe the dimenſions of the planet, whoſe property it is to inlarge all bodies upon the earth; and by one of Sir *Iſaac Newton's* rules, the phænomena in heaven and earth are to be explained from the ſame principles. Concerning the power of fire to dilate bodies, whether it proceed from the ſun or from any thing elſe, Dr. *Boerhaave* has thus determined, p. 212 and 213. "*It may be aſked then, is there no* "*effect of this wonderful cauſe*, (fire,) *which* "*obtains always, and every where the ſame,* "*being alſo utterly inſeparable from fire, and* "*not* variable by objects? *I ſhould believe* "*there is ſuch a one; and ſo far as I have* "*been able to trace the footſteps of nature,* "*there is only one. For on a careful in-* "*quiry, I do not find any body, to which* "*we may not apply that which all men* "*call fire, whether ſolar, culinary, or ſub-* "*terraneous; and all ſuch bodies to which* "*fire is thus applied, without one exception,*

" *are hereby rendered* bigger, *swell, and* " *rarify, yet without any observable diffe-* " *rence in their weight. This equally and* " *uniformly obtains in solid bodies, and flu-* " *id, hard, and soft, light, and ponderous.* " *In the mean while it always appears, that* " *two bodies of the same weight and bulk,* " *one whereof is solid, the other fluid, dif-* " *fer from each other in this, that the flu-* " *id one is more expanded by the same fire,* " *and the solid one less, at least this law* " *obtains in all the bodies which I have had* " *occasion to try.* " The rule of philosophizing, which makes the Chemist's doctrine applicable to the sun and planets, is the following, " *Effectuum naturalium e-* " *jusdem generis eædem assignandæ sunt causæ,* " *quatenus fieri potest.* " Regula 2. Which Sir *Isaac Newton* explains in these words, " *Uti respirationis in homine et in bestia;* " *descensus lapidum in* Europa *et in* Ame- " rica; *lucis in igne culinari et in sole;* " *reflexionis lucis* in terra et in planetis. " It may be here subjoined, that the *fasciæ* of

of the planets, hitherto unaccounted for, are assignable to the same cause, the intense heat of the sun, communicated to a planet at it's conjunction therewith. I have observed these fasciæ assoon as the planet becomes visible from the conjunction; but never before, and not long after the conjunction.

ABOUT the variable dimensions of the *sun* and *moon*, much has been written to very little purpose. I shall only quote the determination of Dr. *Gravesande*, concerning the apparent large magnitude of an *horizontal sun* and *moon*, in the 66th and 67th pages of the volume often referred to in these papers. " *The* " *apparent magnitude of an object depends* " *upon the bigness of the picture in the bot-* " *tom of the eye; which picture depends up-* " *on the angle under which an object is* " *seen; that is, the angle which is formed* " *by lines drawn from the extremities of* " *the object to the eye. This apparent mag-* " *nitude is to be distinguished from the mag-*

"nitude which our mind attributes to the "object that we see; which last is found-"ed upon the judgment, whose foundation "is not in the appearance alone. Every bo-"dy knows that the object appears the less "according as it is more distant; whence "it happens, that according to the greater "distance of the object, if it be known, the "apparent magnitude of the object is in-"creased in the judgment that our mind "makes of it, which we do without any "attention to it. Therefore the same object "at the same distance appears of a diffe-"rent magnitude, if we judge differently of "the distance. We have a remarkable ex-"ample of this in respect of the sun and "moon, which appear greater when near "the horizon, than at a greater height; "though as is known to astronomers, the "picture of the sun in the bottom of the "eye is the same in both cases; and that "of the moon is less when it appears nearer "the horizon; we cannot judge of the dis-"tance in either case, but it appears greater

"*nearer the horizon, by reason of the in-*
"*terposition of the fields and part of the*
"*heavens.*" What the author means by saying, that "*as is known to astronomers,*
"*the picture of the sun in the bottom of*
"*the eye is the same, and that of the moon*
"*is less when it appears nearer the hori-*
"*zon,*" may be understood from what I have quoted from astronomers, in relation to their distances of the sun and moon from the earth. They would persuade us, that the sun is so far distant from the earth, that the earth would be invisible to a spectator placed in the sun; and therefore we must not believe that the magnitude of the sun is really seen to vary with respect to us; although we deceive ourselves with a conceit, that we actually see the sun's diameter larger at some times than at others; and although even astronomers themselves some times speak of the dimensions both of the sun and moon as variable. See a quotation from *Bion* p. 74. So it seems, we must

believe

believe the sun's apparent diameter or "*the picture of the sun in the bottom of* "*the eye to be the same in both cases,*" when the sun is near the horizon, or when it is at the greatest distance from it. Then again with respect to the moon, it is demonstrable, that she is actually nearest to *us* when she rises northerly, and is made apparently nearer in the horizon than the zenith, by the excess of refraction in the former case: yet because astronomers have judged her *apogea* or greatest distances from the earth to be in the northern half of the ecliptic, and her *perigea* or least distances from the earth to be in the southern hemisphere; "*it is known to astronomers, that* "*the picture of the moon is less when it* "*appears nearer the horizon.*" And this authority alone must cause us to reject the evidence of our own eyes; to support the fanciful conceptions of astronomers, in respect to their apogea and perigea; terms by their application fitter for

for the nourishment of a whimsical fancy, than for the employment of a mind soberly considering the works of God.

CHAP. X.

That the order of the planets in the philosophical system is imaginary only.

THE planets according to the hypothesis, have their different distances from the sun, in the following order: 1. *Mercury*. 2. *Venus*. 3. *Mars*. 4. *Jupiter*. 5. *Saturn*. *Mercury* is said to be the nearest of all the planets to the sun by much; and *Saturn*'s distance from the sun exceeds by far the distances of all the other planets taken together. See pages 9th, 10th, and 11th. But on the 30th of *April* 1764, there was a conjunction of the sun and saturn: and at that time, saturn's declination

clination was nearly 13 degrees north, the sun's declination being 15 degrees. Counting 70 instead of 60 miles to a degree, saturn's distance from the sun was *twice* 70 *miles*, not 700 *millions of miles* and upwards. At the same time, mercury's declination was nearly 18 degrees north, that is, three degrees from the sun or 210 miles, and consequently higher above the earth, with respect to us, than saturn; when the latter was but two degrees or 140 miles distant from him. In the preceding month of *March*, mercury was at a much greater distance from the sun, namely, at the distance of 12 degrees or 840 miles, not however 32 *millions of miles*.

EVEN the *moon* which is placed infinitely nearer to the earth, in a manner, than some of the other planets, and particularly 70 or 80 millions of miles nearer than the sun, appears plainly to equal the sun in her height above the earth, by the oppositions, and conjunctions

tions, and eclipses of the sun and moon. The eclipse of the sun on the sixteenth day of *August* next, demonstrates the moon to be more elevated in that conjunction than the sun, with respect to our observation: since the upper limb of the sun is eclipsed by the lower limb of the moon. And she goes much further from us towards the south than the sun does. These are points to which philosophers should have attended, deriving their doctrine from facts and phænomena, not from useless rules and conjectures, which I am next to consider.

CHAP. XI.

That Kepler's *famous rule has no place in astronomy.*

ASTRONOMERS make this rule the basis of their philosophy respect-

ing the motions of the planets, that *the squares of the periodical times are as the cubes of the distances*; which the reader may see illustrated by example in Dr. *Keill*'s astronomy, so often cited, p. 36. It was brought as a proof of the earth's motion from Dr. *Gravesande*, that *jupiter's and saturn's satellites* move round the sun by this rule, " *that the squares of the pe-* " *riodical times follow the ratio of the cubes* " *of the distances.* " Whence the earth's motion " *is deduced from the analogy of* " *the motions.* " For this rule, it is said, " *may be applied to the earth if it be car-* " *ried about the sun with the rest of the* " *planets.* " Otherwise, " *this rule has one* " *exception.* And, " *in this respect, the a-* " *nalogy of the celestial motions would be* " *disturbed.* " This is also the first of " what Sir *Isaac Newton* sets down for phænomena: " *Planetas circumjoviales, ra-* " *diis ad centrum jovis ductis, areas descri-* " *bere temporibus proportionales, eorumque* " *tempora periodica, stellis fixis quiescentibus,*

" *esse*

" *esse in ratione sesquiplicata distantiarum ab* " *ipsius centro.* " The Philosopher saith, this is proved by observations. " *Constat* " *ex observationibus astronomicis.* " Yet with all just deference to Sir *Isaac*'s memory and great character, I presume to say, he has not proved his assertion by the observations which he hath quoted. The 4th satellite was observed to be distant from jupiter about 8′. 16″. And the distance of the 3d satellite from jupiter was observed to be 4′. 42″. At these distances, the rule, it seems, will answer to their movements. But what if the proportion of their distances be very different from that which the illustrious author assigns them, in consequence of these observations? In this case, it is certain the rule fails, where it was judged to hold good. Be it remarked then, that the 4th satellite was observed by a tube of 15 feet long, " *tubo quindecim pedes longo.* " p. 390. And the 3d satellite was observed by a telescope 123 feet long, " *telescopio*

" *pedes* 123 *longa.* " p. 391. Now will not the longer telescope magnify more than the shorter one? And stars are set at greater distances, as the magnifying power of the telescope is greater. See pages 52d and 53d. We have the author's own authority, that long telescopes magnify beyond short ones. " *Long telescopes may cause* " *objects to appear brighter and larger than* " *short ones can do, but they cannot be so* " *formed, as to take away that confusion* " *of the rays which arises from the tremors* " *of the atmosphere.* " Optics, p. 98. He gives us also the proportions between the magnifying powers of telescopes having different lengths, p. 89. Whence according to his own method of computing and proportioning these powers; the telescope which is 123 feet in length, magnifies almost 3 times as much as the other of 15 feet. Wherefore the distances of the two satellites should have been taken by the same instrument; and then, the perspective which set the 3d satel-

lite

lite at the diſtance of 4′. 42″ from jupiter's centre, would have ſhewed the 4th ſatellite at the diſtance of about 24 minutes from the ſame centre; which makes a wide difference from the diſtance that agrees with the rule; and by conſequence, proves the rule not to anſwer to phænomena, and that it ought therefore to be diſregarded.

WITH reſpect to *jupiter's diameter*, Sir *Iſaac* writes, that the long teleſcope made it always leſs than 40″, and never leſs than 38″, when it was reduced to jupiter's mean diſtance from the ſun or the earth. In ſhorter teleſcopes, this diameter is, as he ſaith, 40″ or 41″. "*Diameter jovis micrometro in teleſcopio pe-* "*des* 123 *longo ſæpius capta fuit, et ad* "*mediocrem jovis a ſole vel terra diſtanti-* "*am reducta, ſemper minor prodiit quam* "40″, *nunquam minor quam* 38″, *ſæpius* "39″. *In telecopiis brevioribus hæc diame-* "*ter eſt* 40″ *vel* 41″." Princip. p. 391. The doctrine would appear altogether ſur-

prizing

prizing, that the short telescope should make the diameter of the planet more than it was made by that which was 8 times longer; when we had seen before that the same author taught the contrary, making the longer telescope to magnify about 3 times as much as the shorter. But the reason immediately follows. " *Nam lux jovis per inæqualem refrangibi-* " *litatem nonnihil dilatatur, et hæc dilatatio* " *minorem habet rationem ad diametrum jo-* " *vis in longioribus et perfectioribus telesco-* " *piis quam in brevioribus et minus perfec-* " *tis.* " And this agrees with what is delivered in the *optics* to the same effect. As in p. 87. " *The sensible image* " *of a lucid point is therefore scarce broader* " *than a circle, whose diameter is the 250th* " *part of the diameter of the aperture of* " *the object-glass of a good telescope, or not* " *much broader, if you except a faint and* " *dark misty light round about it, which a* " *spectator will scarce regard. And therefore* " *in a telescope, whose aperture is four inches,*

" *and*

" *and length an hundred feet, it exceeds not* " 2″. 45‴, *or* 3″. *And in a telescope,* " *whose aperture is two inches, and length* " 20 *or* 30 *feet, it may be* 5″ *or* 6″, *and* " *scarce above.*" But surely there was a defect in the perspectives, which exhibited the " *faint and dark misty light round* " *about* " the object. For an object seen under such circumstances, is seen without perfecting the focus of the telescope. I can shew a star much larger, I believe, than the sun, by moving the speculum in my telescope either way, beyond it's proper place. But when the focus is perfect, a star is as accurately defined as any terrestrial object. But I should imagine, that it is almost or altogether impossible, to have a perfect focus at all times in the long telescopes; since the least bend or shake of the instrument must alter the focus, if all matters could be so happily adjusted at any one time, as not to have a hair's breadth too much or too little any way, in the disposition

and

and preparation for the making of an observation. And this perhaps may partly account for the different diameters of the planets, as observed by different astronomers, famed for their abilities in this way; which was remarked from *Wolfius*, p. 91. Neither did this escape the penetrating genius of the Philosopher; who was very sensible of the imperfection of telescopes, and contributed to their improvement, even by his own manual operation. He attributes this imperfection to the different refrangibility of the rays of light, which is a point that I am not to discuss for the present. Yet he admits also, that it was difficult to make an observation distinctly by the telescopes then in use. " *But by reason of this different* " *refrangibility, I do not yet see any other* " *means of improving telescopes by refrac-* " *tions alone, than that of increasing their* " *lengths, for which end the late contrivance* " *of* Hugenius *seems well accommodated. For* " *very long tubes are cumbersome, and scarce*

" *to be readily managed, and by reason of* " *their length are very apt to bend, and* " *shake by bending, so as to cause a con-* " *tinual trembling in the objects,* whereby " it becomes difficult to see them dis- " tinctly: *whereas by his contrivance the* " *glasses are readily manageable, and the* " *object-glass being fixed upon a strong up-* " *right pole becomes more steady.* p. 91. Now this method of *Hugenius*, which is approved by Sir *Isaac Newton* and commended by *Wolfius*, gives the diameter of jupiter in a very different measure from that which *Kepler*'s rule requires. For to suit the rule, the mean diameter ought to be $38''$, as was shewn from the *Principia:* whereas the least diameter of jupiter according to *Hugenius* is $1'. 4''$, which is more than double the measure that *Kepler* makes the least, as may be seen in the table p. 91. On the other hand, these dimensions are by *Hevelius* made less by half than *Kepler* had determined them. It is further observeable in

the table, that not one of the calculations respecting the diameter fits the rule, save *Kepler*'s own measure only. Also upon the *theory of the revolutions* of jupiter's satellites, I must crave leave to remark, that it looks more like a deduction from *Kepler*'s rule, than from any thing like an accuracy of observation. Upon the whole if regard be had to observations, the rule is found not to agree with the phænomena of *jupiter* and his *satellites*.

UPON examining whether *Kepler*'s rule merits that esteem which it has obtained, for it's supposed use in determining the motions of the planets, I could not help reflecting on the strange fancies of philosophers, in attempting to illustrate a supposed law of motion by the system of the satellites. The first of jupiter's satellites is, according to the Philosopher, less than two minutes distant from the centre of jupiter; and this in english measure is about an eighth

part

part of an inch; which the line of philosophy stretches to 130,000 miles. p. 11. Who can pretend to determine in such a minute space as the eighth part of an inch, at what instant of time precisely the satellite has attained it's utmost elongation, and that not the least error is made in the observation? And the mistake of a hairs breadth makes a difference of many thousand miles in the hypothesis. They should apply the rule to cases, in which sense and experiment may determine certainly, whether the rule holds good or not. Apply it to the moon's revolution in particular, which is the nearest planet to us, and see how it answers there. Why here the rule fails. Sir *Isaac* indeed introduces this in his *Principia* as a phænomenon: "*Lunam* "*radio ad centrum terræ ducto, aream tem-* "*pori proportionalem describere.*" p. 394. Yet he owns there is some confusion, which he imputes to the sun's effect upon the moon. But Mr. *Whiston* fairly ac-

knowledges, that we must be content with an *hypothesis*, instead of a perfect theory of the moon's motions by the true causes. " *Ad lunam nos accingimus. Lunam* " *inquam, planetam secundarium, tot motibus compositis, tot ambagibus, perplexisque* " *anomaliis obnoxium, ut eandem, nobis licet proximam, et quasi in vicinia positam,* " *astronomicisque scrutiniis mirum in modum* " *vexatam, vix aut ne vix quidem numeris* " *subjicere* etiamnum valemus. —— *Veras inæqualitatum lunarium causas earumque calculum solus* Newtonus *attingere* " *potuit. Utinam vero lunæ theoriam, quam* " *in animo olim habuit idem vir maximus,* " *integram absolvisset, et in publicum emisisset! ut ejusdem motus per causas veras* " *demonstratos, et absque* hypothesibus fictitiis *stabilitos haberemus! At vero nobis* " *adeo esse beatis* nondum licuit. *Reperto* " *tritico glandibus vesci aliquantisper, et loco absolutæ theoriæ* lunari hypothesi *contentos abire oportebit.* " p. 93. From hence it is visible, that all the imaginary

nary improvements in the knowledge of the nature and course of the moon, vanish into smoke: and no more than the knowledge how to calculate her age and eclipses is yet obtained; which I take to be less than was known in ancient times. The *Jews* knew the way to find the age of the moon, as appears in the 20th chapter and 5th verse of the first book of *Samuel:* where *Jonathan* is advertised by *David*, " *Behold to mor-* " *row is the new-moon*, " &c. And eclipses were foretold amongst the *Romans*, who were not famed for their skill in the sciences, long before the commencement of their imperial government; as may be seen in the 44th book of *Livy:* where one of *Emilius*'s captains, in the war against *Perseus* king of *Macedonia*, by the Consul's approbation, addressed the army with a speech to prevent their dismay at the eclipse of the moon, which would happen as he informed them on the next day, the hour of it's commence-

ment

ment and the duration also being foretold by him. And the Historian acquaints us, that the eclipse happened at the hour predicted. The passage deserves attention. " *Castris permunitis*, C. Sulpicius Gallus " *tribunus militum secundæ legionis, qui præ-* " *tor superiore anno fuerat, consulis permissu* " *ad concionem militibus vocatis pronuncia-* " *vit:* nocte proxima, ne quis id pro " portento acciperet, ab hora secunda " usque ad quartam horam noctis lu- " nam defecturam esse. Id quia natura- " li ordine statis temporibus fiat, et sciri " ante et prædici posse. Itaque quem- " admodum, quia certi solis lunæque et " ortus et occasus sint, nunc pleno or- " be, nunc senescente exiguo cornu ful- " gere lunam non mirarentur: ita ne " obscurari quidem, quum condatur um- " bra terræ, trahere in prodigium de- " bere. " lib. 44. sect. 37.

It is very remarkable that the cause of an eclipse of the moon, is in this passage of *Livy* imputed to the earth's shadow,

dow, agreeably to the preſent prevailing notion amongſt aſtronomers. *Plutarch*, in his life of *Paulus Emilius* ſpeaking of this ſame eclipſe, gives likewiſe the ſame explanation of lunar eclipſes as was found before in *Livy*. Which ſhews that the preſent opinion is far from being modern. Indeed the *Copernican* philoſophers pretend to derive their ſyſtem from *Pythagoras*, who lived and came to *Italy* according to *Livy* in the reign of *Servius Tullius*. " Samium Pythagoram *edunt* : " *quem* Servio Tullio *regnante* Romæ, — " *in ultima* Italiæ *ora circa* Metapontum " Heracleamque *et* Crotonem, *juvenum æ-* " *mulantium ſtudia cœtus habuiſſe conſtat.* " l. 1. ſ. 18. And if they can prove that *Pythagoras* taught the *Copernican* philoſophy, and accounted for the moon's eclipſes upon theſe principles; then it follows, that this error had exiſtence 600 years before CHRIST, and perhaps much earlier than that period. Which I do not wonder at, foraſmuch as the *Greeks* had

their

their learning late, compared with the eastern nations; and were more likely through vanity to offer some reason for explaining a phænomenon, however foreign from truth, than to confess their ignorance. But it is very clear, that the hypothesis doth not answer the purpose which it is produced to serve. When we look round about us in a fair day, the sun shining bright in some parts of the prospect, other parts are often shaded by the passage of clouds over them. But these shadows do not take the places from our view; for the hedges and fields are distinctly perceived in the shadow, only they are not so bright in this faint light as when the sun's force is full upon them. Therefore if the moon came into the earth's shadow, it would appear just as a thin cloud shews it to us, in it's usual form and colour, but less brilliant, than when exposed to the open sun-beams. This would happen if the moon was indeed an opaque body. But

as

as it has been demonſtrated to have light in it ſelf, the ſhadow of the earth cannot render it dark, as almoſt every day's experience teaches us. For the moon is almoſt continually in the earth's ſhadow when ſhe appears after the ſun is ſet, and enlightens the parts of the earth which are covered with the ſhadow, inſtead of being eclipſed thereby. Yet according to philoſophy "*ſhe is covered* "*with darkneſs, when the earth is between* "*her and the ſun.*" See p. 22.

THE motions of the primary planets agree no better with *Kepler*'s admired rule, than the ſecondaries, as they are called, of jupiter, and of the earth. We are taught by philoſophy, that all theſe bodies move from the weſt to the eaſt till they come in conjunction with the ſun, then they return, to revolve round about him. But experience teaches the contrary, with reſpect to all the planets whoſe motions are perceived by us. It will be enough to illuſtrate this in the

movements of one planet only, for if the rule fails in one case, it fails of course in all the others. When *mars* was last in his retrograde motion, any one might have seen him plainly pass from east to west by the *scorpion's heart*; at which time he was moving directly forward the contrary way, from west to east, by the rule; and so his heliocentric motion is set down in an ephemeris. And that is the motion which astronomers tell us we must regard as the true motion, not what our eyes inform us to be the motion of the planet. This doctrine is clearly delivered in *Regnault*, p. 232. "Eudox. *You will also find, no doubt, in* "*the unequal revolutions of the planets* "*round the sun, their directions, stations,* "*and retrogradations; and these will be* "only appearances. Arist. *They say that* "*the planets are* direct, *when we see them* "*advance from the west toward the east,* "*according to the order of the signs of the* "*zodiac*; stationary, *when they seem to* "*stay*

" *ſtay in the ſame part of the heavens;*
" retrograde, *when they appear to retire*
" *toward the weſt. Now this may happen*
" *from the inequality of their velocity. They*
" *run thro' their orbits in unequal times.*
" *This inequality is the cauſe why* the earth
" paſſes more frequently or more rarely
" between the ſun and the ſuperiour pla-
" nets, during their revolution, *and why*
" *the inferiour planets namely mercury and*
" *venus, paſs more frequently or more rare-*
" *ly between the earth and the ſun.* "
Wherefore " 1. The earth follows, o-
" vertakes, and precedes the ſuperiour
" planets. *If the earth follows a planet,*
" *the planet appears* direct. *Does the earth*
" *overtake a planet? the planet appears* ſta-
" tionary; *becauſe the exceſs of velocity,*
" *which happens in the earth, renders the*
" *motion of the planet imperceptible toward*
" *the ſame place, and makes the eye refer*
" *it for ſome time to the ſame place of the*
" *heaven. Does* the earth precede the pla-
" net conſiderably? *The eyes refer the pla-*

" *net to a more remote part of the hea-*
" *vens, and* it seems retrograde. 2. *We*
" *see those* appearances *in the superiour pla-*
" *nets,* because they compleat their orbits
" more slowly than the earth. *They ob-*
" *serve those appearances in the inferiour*
" *planets, because they make their revolutions*
" *round the sun more swiftly than the earth.*
" *By reason of this excess of velocity, some-*
" *times they go before the earth from west*
" *to east, and appear* direct. *Sometimes they*
" *are in conjunction in the same line with*
" *regard to some sign, going toward the*
" *same part; and they seem* stationary.
" *Sometimes in the inferiour part of their*
" *circle, they pass again from east to west,*
" *leaving the earth very far behind them,*
" *and they are* retrograde. *Hence the diffe-*
" *rent appearance of* directions, stations,
" *and* retrogradations. " If we assent to
this doctrine, we must suppose, contrary
to the report of our eyes, that *mars* did
not return westward in the months of
May and *June* last, from about 17 degrees

to

to 3 degrees in *ſcorpio* called *ſagittary* at preſent; but that he kept forward according to the order of the ſigns from *ſcorpio* to *ſagittary*, and from *ſagittary* to *capricorn*. And whereas things appeared otherwiſe to the eye, theſe we muſt ſuppoſe to " *be only appearances.* " Which happened, as we are taught, " *by the* " *earth's paſſing between the ſun and the* " *ſuperiour planet* " mars. In which caſe, " *the eyes refer'd the planet to a more re-* " *mote part of the heavens*, to the ſcor- " pion's heart, *and he* ſeemed *retrograde.* " But it has been largely ſhewn, that the ſtars are by no means referable to the very " *remote parts* " whither aſtronomers ſend us to look for them. And as for the " *earth's paſſing between the pla-* " *net and the ſun*, " although it has been evidently demonſtrated already that the earth is without motion, it may not be utterly impertinent, to enquire what information our ſenſes give us in this matter. Mars at that time was near the

southern tropic, and the sun was near the northern tropic: yet this distance did not give room enough for the earth to pass between the planet and the sun. For the earth could not pass without carrying her inhabitants the way that she went. And we who dwell on this side the tropics were not brought between the sun and the planet; since they were both very far south from us; neither were the dwellers on the south side of the tropics brought between the planet and the sun; as they were both of them a good way north from the southern inhabitants of the earth; the sun being most remote from these people, as the planet was from us. What say you? Will you trust to the hypothesis of the earth's motion, or believe your own sight? Why it seems most judicious to trust to the direction of our own eyes, untill we find better guides not liable to deceive us.

CHAP.

CHAP. XII.

Concerning Sir Isaac Newton's *doctrine of gravitation.*

THE fame of this great philosopher may create an opinion amongst partial and prejudiced reasoners, that a man ought not to contradict, or even suspect the truth of what has been taught by that genius, who has gained a most extensive if not universal admiration. The great Dr. *Boerhaave* speaks of the Philosopher most respectfully, p. 363, "*a philosopher whose subtle and penetrating genius seems to have surpassed the limits prescribed to human understanding*" Yet he is not inclined by the respect which he pays him, to believe implicitly every tittle that the Philosopher believed, who as a man was liable to be mistaken with other men. The Chemist esteems fire

void

Sewell

void of gravity, notwithstanding the experiments by which it was thought to have been proved a property in body. He relates the experiments "*out of the* "*regard which he bears to the truth*;" and shews that the increased gravity in bodies by the application of fire, may proceed from particles of the instruments used in making the experiments. And he concludes with a suggestion, that the particles even of glass may rather separate from the vessel, to increase the gravity, than that this increase is imputable to the quantity of fire. "*An increase of weight* "*does not happen in all bodies calcined, but* "*only in those abounding with a rapacious* "*sulphur, as antimony, lead, tin, iron, and* "*orpiment; whence this addition is, per-* "*haps, owing to the corrosion, attrition,* "*and mixture of the particles of the sul-* "*phur, with those of the other bodies, se-* "*parated by fusion in such operation. But* "*the increase of weight, in bodies exposed* "*in glass vessels from the supposed insinua-*

"*tion*

" *tion of fire into them, is so small, that* " *it may, perhaps, rather be ascribed to* " *something communicated to them from the* " *glass it self.* " p. 340. Again, p. 359, he almost positively denies the property of gravity to fire. " *But whether fire have* " *also that further property, which some* " *of the greatest men of the present age hold* " *inseparable from all bodies,* viz. *weight or* " *gravity, in proportion to it's solidity, does* " *not so certainly appear from the consider-* " *ation of the whole history of fire. I am* " *rather induced to believe, that it has no* " *more tendency to the centre of the earth* " *than to any other point; that it has no* " *natural or spontaneous determination at all,* " *that it may be determined any way; that* " *it is present every where, unless hinder'd* " *by some foreign cause, through the whole* " *universe; that of it self it is every where* " *in the same quantity, and acts with the* " *same force: all which particulars, unless* " *I am much deceived, have been* proved *by* " *the preceding experiments.* " From hence

it seems, that the æthereal system of the sun is not subject to the gravity of the earth.

And that the planets are subject to this influence, is only deducible from hypotheses. Sir *Isaac* supposes the earth a planet of the same nature with the rest of the planets, and that the gravity which pertains to the earth, pertains to the moon. He builds likewise upon his first and second phænomena. Whereas the first has been proved an hypothesis; after which, there is no occasion for examining the nature of the second. And from such premisses he draws this conclusion, "*Gravitas igitur datur in planetas universos. Nam venerem, mercurium* cæterosque *esse corpora ejusdem generis cum jove et saturno, nemo dubitat.*" p. 399. But no doubt can remain with any one of the contrary, who has attended to the arguments contained in these papers, proving from phænomena, that the planets are not opaque bodies like the earth; and

and that the earth is a fixed body unlike to a planet. And this is a ſure way to a juſt determination concerning the merit of the *Newtonian* principle, *viz.* to compare the ſyſtem explained by it with phænomena.

Now we ſee the ſun come from the ſouth towards us in the north, at the approach of ſummer; and we ſee him return again to the ſouth, in the winter ſeaſon. This is a deception of the ſight according to the *Newtonian* philoſophy; and the earth *really* carries us by her own motion from the north towards the ſouth, when the ſun *apparently* advances the contrary way. By which motion, we are reported to make a tour of 4 or 500 millions of miles, from the time of our departure to our return. Yet in a journey of ſuch an amazing compaſs, we ſee no new objects in the celeſtial regions which we paſs through. Neither can we perceive in our paſſage, any diminution in the proportions of the ob-

jects which we leave behind us; nor do we discover any increase in the proportions of the objects to which we approach. Although the same vehicle conveys a whole world of spectators; not a single individual amongst us all can pick up any intelligence, to be related after the accomplishment of this long journey. Which remarkable circumstance in travelling, to go so far, and yet to see nothing more than might be seen without going a mile from home, seems more strange than the strangest relations of travellers, concerning things which nature knows nothing of. At the remotest point of our journey, we are said to be at the distance of 160 millions of miles and upwards from the place of our departure; no new stars appearing, by such an approach towards places where new stars are known and acknowledged to exist; the stars which we leave at such a prodigious distance behind us not diminishing to our sight; and these to

which

which we come 160 millions of miles nearer than we were at the beginning of the voyage no way inlarged in their appearance, by ſuch a difference of approximation; the ſpaces between two ſtars being alſo unaltered. But an artificial approach by a teleſcope, of a very few miles towards any part of the heavens ſhews new ſtars; and new ſpaces between two ſtars, that appeared almoſt touching one another, at the diſtance from whence they were ſeen without a teleſcope. And as a real and actual approach towards objects, affects our ſenſes more clearly than an artificial approach by a teleſcope; we could not fail of ſeeing the alteration of objects, and a dilatation of the ſmall ſpaces between them, by a real and actual approach. But it is acknowledged, that no ſuch alteration is perceptible to our ſenſes: therefore a demonſtration ariſes, that no ſuch approach is made; which would neceſſarily make a very ſenſible alteration. In other words, it is hence demonſtrated,

monstrated, that the motion belongs to the sun, not to the earth.

We also learn by experiment, that a mere shadow can no more prevail over or eclipse the light of the moon, than it can prevail over or eclipse the light of the sun. And we may learn from phænomena, that the supposed enlightened face of the moon by the sun, is never visible to *us* in the winter season. As our latitude is about 51 degrees north of the line; when the moon is near her elongation northward, which is about 28 degrees or 1960 miles on this side of the equinoctial; and the sun is also near his elongation southward, which is about 23 degrees or 1610 miles beyond the equinoctial; as it fell out in the month of *December* last; we are about 1610 miles distant from the moon, and about 5180 miles distant from the sun. We are therefore very far from a situation between the moon and the sun, in which situation only, it is possible to see what is

called

called the enlightened face of the moon by the ſun. If the moon has, according to the hypotheſis, a light and a dark ſide; we are always in the winter ſeaſon on the dark ſide of the moon, yet we ſee a light ſide by a full moon in winter as in ſummer.

It may be not amiſs to take notice here, that the diſtances of the ſun and moon from the equator are not altered by their ſhining above or below the horizon. We are many hundreds of miles north from the moon, and ſome thouſands of miles north from the ſun, *by day or night*, towards the depth of winter. Yet we ſee the face of the moon fully enlightened which ſhe ſhews to us: and this is the reverſe of the ſide turned towards the ſun; whoſe light therefore cannot be the cauſe of light on the face of the moon which we ſee. A demonſtration, that the light is not derived from the ſun.

It has been alſo demonſtrated in the

preceding

preceding pages, that the phænomena of the other planets are irreconcileable to the *Newtonian* theory. And the same thing might have been further illustrated, in more instances than have been produced in these papers; which however will come to be considered in the explication of the system of nature, by the assistances which *Moses* has given us.

WHEREFORE the natural conclusion concerning the principle of gravitation, is, that as Sir *Isaac Newton* has introduced it in astronomy to support an hypothesis, and not to explain a system of nature: it must be subject to the judgment which the author of it has given upon hypotheses, almost at the very conclusion of his philosophy. "*Hypotheses* "*non fingo. Quicquid enim ex phænomenis* "*non deducitur*, hypothesis *vocanda est*; *et* "*hypotheses seu metaphysicæ, seu physicæ,* "*seu qualitatum occultarum, seu mechanicæ,* "*in* philosophia experimentali *locum non* "*habent.*" P. 530.

CHAP.

CHAP. XIII.

That the philosophical opinion concerning comets, is also an hypothesis.

THE movements of comets in their proper orbits, are as confidently spoken of by astronomers, as if it was a matter known, and determined by phænomena. " *Diximus cometas esse genus pla-* " *netarum in orbibus valde eccentricis circa* " *solem revolventium.* " Princip. p. 517. Their revolving in orbits so very eccentric, causes their movements to be very slow in one part of their course; and is assigned as the reason why their returns have not been more certainly determined heretofore. For of late, if we can credit their assertions, the theory of comets is ascertained, by the return of the comet which appeared in 1682, within two years of the time in which it

ought to come about, according to the theory. The exultation of Mr. *M*—— upon the appearance of a comet in the month of *May* 1759, which he takes to be the comet of 1682, deserves to be quoted. " *The comet, which at this time* " *makes it's appearance, has all the cha-* " *racteristics of that which appeared in the* " *year* 1682, *and therefore is undoubtedly* " *the same. And as it is the first comet* " *which has been predicted, and has return-* " *ed* exactly *according to that prediction,* " *it cannot but excite the attention and ad-* " *miration of the curious in general, and* " *fill the minds of all astronomers with a* " *ravishing satisfaction, as it has by this re-* " *turn, confirmed Sir* Isaac Newton's Ra- " tionale *of the* solar system, *verified the* " *cometarian theory of Dr.* Halley, *and is* " *the first instance of astronomy* brought to " *perfection; and therefore has signalized* " *this age above all, from the* beginning " of the world; *and will perpetuate the* " *names of the above Gentlemen, and ren-*

" *der*

" *der them venerable through all the ages*
" *of posterity.*

" *Sir* Isaac Newton *first demonstrated,*
" *that by one and the same principle,* viz.
" *the* power of gravity, *all the motions of*
" *the mundane system were produced and re-*
" *gulated; and that the primary planets,*
" *the satellites, and comets, have the* squares
" of their periods *proportioned to the* cubes
" of their distances.

" *Dr.* Halley *knew, on that principle,*
" *the* time of a comet's return *might be*
" *foretold* almost as certainly *as that*
" *of a planet, if it's period could be but*
" *once deduced from observations made on it*
" *heretofore. To this arduous task he there-*
" *fore addressed himself, and collected such*
" *observations from history as seemed fully to*
" *satisfy him with regard to the periods of*
" *two of the comets,* viz. *that of* 1680,
" *and of* 1682; *but the former of these*
" *proving a period of* 575 *years, put the*
" *observation of it's return at so great a*
" *distance, as makes it for several ages to*

" *come of no use. But happily for himself*
" *and us, the comet of* 1682, *has it's pe-*
" *riod the shortest of all, and for that rea-*
" *son he did, with a becoming spirit and*
" *confidence, predict it's return, and lived*
" *himself within a few years to see his own*
" *prediction accomplished in the appearances*
" *of the* present comet.

" *This great Astronomer observes, that if*
" *the comet were influenced by no other power*
" *but that of the sun, it's return would be*
" *very regular, and in equal periods of time;*
" *but since the comets, in their motions to*
" *and from the sun, must pass by the or-*
" *bits of the large planets,* jupiter *and* sa-
" turn, *they are liable to have their mo-*
" *tions disturbed, their velocities (in* peri-
" helio) *altered, and consequently the times*
" *of their period, place of the nodes, and*
" *inclination of their orbits, varied and ren-*
" *dered in some degree uncertain.*

" *Thus it has happened with regard to*
" *the present comet, whose last period was*
" *not quite* 75 *years; but at it's return to*

" *the*

" *the ſun in* 1682, *it came ſo near to* ju-
" piter, *and ſtaid ſo long in it's neighbour-*
" *hood, as to acquire an accelerated motion*
" *by the united forces of the ſun and* ju-
" piter, *that it went off with greater ve-*
" *locity than it came, and therefore to a*
" *greater diſtance than before, conſequently,*
" *the time of it's return was thereby made*
" *longer, and occaſioned the Doctor to ſay,*
" *that it would probably not return 'till the*
" end of the year 1758, *or the* begin-
" ning of the year 1759; *at which times*
" *it* moſt accurately *has appeared, and fixes*
" *the* Æra *of perfection in this* celeſtial
" ſcience. "

MR. *M*—— obſerved this comet eaſt-ward of *hydra's heart* on the 5th of *May*. He alſo points out the place where it had been obſerved by another perſon on the 2d, ſouth-eaſt of the place in which he obſerved it. Mr. *M*—— gives us likewiſe the place of it's appearance on the 6th, 18th, and 21ſt days of the ſame month, and no further; by which he de-

ſcribes

scribes the way of the comet to be from eastward to westward, from the hinder part of *hydra* to the fore part of *leo*.

THE comet of 1682 is fully described in the *Principia*; from whence by comparing the appearances of that comet with the appearances which Mr. *M*—— has given us of the other; it can be no difficult task to determine the identity or non-identity of the two comets.

THE comet of 1682 was supposed by Sir *Isaac Newton* to be the same which had been observed in the year 1607. But to be certain of the sameness of a comet, and to settle the time of his revolution precisely; the illustrious Author proposes, that divers observations should be made upon the appearances of a comet in his different revolutions, when the appearances seem to indicate the same comet; and if *many comets* are found to describe the *same orbit* after *equal intervals of time*; it is to be concluded, that all these are one and the same

comet

comet revolving in the ſame orbit. " *Cæ-*
" *terum cometarum revolventium tempora pe-*
" *riodica, et orbium latera tranſverſa, haud*
" *ſatis accurate determinabuntur, niſi per*
" *collationem cometarum inter ſe, qui diver-*
" *ſis temporibus apparent. Si plures cometæ,*
" *poſt æqualia temporum intervalla, eundem*
" *orbem deſcripſiſſe reperiantur, concludendum*
" *erit hos omnes eſſe unum et eundem cometam,*
" *in eodem orbe revolventem. Et tum demum*
" *ex revolutionum temporibus dabuntur orbi-*
" *um latera tranſverſa, et ex his lateribus*
" *determinabuntur orbes elliptici.* " p. 519.
Let us now compare the appearances of the two comets, according to the method propoſed by the Philoſopher, and ſee whether there be any manner of reaſon for concluding theſe two to be one and the ſame comet.

By the table in the *Principia* p. 523, we ſee that the firſt place of the former comet's appearance was in the ſign *leo*. By the obſervations made of it's courſe, it paſſed, as in the table, from *leo* through

virgo

virgo, and *libra*, to *scorpio*: where the observations cease. Whence the appearance of the comet of 1682 was near the north tropic; whereas the appearance of the comet in 1759 was near the south tropic. And the way of the former comet was from the west to the east; whereas the way of the latter comet was from the east to the west. Lastly the time of the supposed return of the former comet was a period of 75 years, from 1607 to 1682. The supposed period of the other's revolution, was from *August* in the year 1682 to *May* 1759; almost two years more than the space allowed for it's return by Sir *Isaac Newton*. " *Si cometæ hi* " *duo fuerint unus et idem, revolvetur hic* " *cometa spatio annorum* 75, *et axis major* " *orbis ejus erit ad axem majorem orbis mag-* " *ni ut* — 1778 *ad* 100 *circiter. Et dis-* " *tantia aphelia cometæ hujus*, &c. — *At-* " *que hæc ita se habebunt si cometa spatio* " *annorum septuaginta quinque, in hoc orbe* " *postbac redierit.* " p. 524, 525. Here the

the proof of the identity, is put upon the comet's returning in the orbit of the former, and in the ſpace of 75 years. But the comet which is the preſent ſubject of diſpute, neither returned in the orbit, nor period of the former: it's appearances being ſo different as eaſt and weſt, and north and ſouth; the difference in point of time being alſo not a few days, or weeks, or months, but not much leſs than two years. Wherefore as it differs intirely in every reſpect, from the tokens which Sir *Iſaac Newton* has given us, whereby to determine the identity or difference of the two comets; if we regard his judgment and determination, and reject hypotheſes, the comets were not one and the ſame, but two comets, not at all alike to each other. And from hence we may conclude with the utmoſt ſafety, that the theory of comets is no better eſtabliſhed than it was of old; and that the deductions from hence in fa-

vour of the *Newtonian* system are without weight.

CHAP. XIV.

That the modern system of philosophy is of no service to Religion.

PHILOSOPHERS often close their accounts with an encomium upon their system, as if it tended to promote acts of Religion. The panegyric on the late discoveries in respect of the nature of comets, concludes with an observation, that we have hereby a motive to thankfulness which the Psalmist wanted; whose praises, as far as can be judged, rather exceeded than came short of the praises of other men. " *If* David, *who* " *probably knew little of the planetary sys-* " *tem, and nothing of the cometary, had* " *such exalted notions of the works of na-* " *ture,*

" *ture, and the adorable Author of them;*
" *with how much greater reason and pro-*
" *priety, may we who are now gratified*
" *with a competent knowledge of both, ex-*
" *claim in a religious extasy*: — The
" heavens declare the glory of GOD,
" and the firmament sheweth his handy
" work!" But it is now evident, that this is no foundation for transports of praise towards the ALMIGHTY CREATOR, who is not the author of the system which philosophers have applauded and admired. The principle then which is judged a source of admiration and praise, can only tend to promote unbecoming sentiments amongst vain men, admiring their own chimerical creations, and despising the true system of nature, as GOD has appointed and revealed it, by his servant *Moses*. And it is high time to consider, that no praises are due to our selves for imaginary discoveries; that humility belongs to men; that the opposite quality was the ruin of beings once superi-

our to us; and that the influence of the principle which brought ruin upon them, will infallibly draw to ruin all such as are vain enough to submit to that influence. If we think our praises are due to the CREATOR for his works, we must praise him for what he has actually wrought: and that is to be sought from his own declarations concerning his glorious and mighty acts; and not from a supposition, that he has actually wrought expresly contrary to what he has told us of his works; and that the human weakness can invent a better system than that which GOD has created and revealed.

PERMIT me to say further, that philosophy would be of no service to Religion, if it performed all that it promises that way, if it demonstrated the being of GOD, which it doth not. The belief of GOD's existence is nothing, if there be not also a belief of his providence, or government of the world; according

cording to the Apostle, "*He that cometh* "*unto* GOD, *must believe that He is, and* "*that He is a rewarder of them that di-* "*ligently seek Him: without* which *faith* "*it is impossible to please Him.*" Hebrews xi. 6. When a man is brought to a belief that GOD governs the world, and that it is good for him to live under His government; he is then just entered into the way which leads to the valuable treasures of knowledge. Believing it best for us to be subject to GOD's rules and appointments, we shall not impiously presume to teach our CREATOR the science of government, and to tell the OMNISCIENT, that wisdom requires him to govern by himself, without admitting his SON, or SPIRIT, to a participation of power or government in the world. Believing it best for us to be subject to GOD's rules and appointments, we shall not rebel against him for appointing his SON the JUDGE of our actions, that reverence may be paid to him also as well as

to

to the FATHER. "*For the* FATHER *judg-*
"*eth no man, but hath committed all judg-*
"*ment unto the* SON, *that all men should*
"*honour the* SON *even as they honour the*
"FATHER: *he that honoureth not the* SON,
"*honoureth not the* FATHER *which hath*
"*sent him.*" *John* v. 22, 23. The Jews undoubtedly acknowledge and worship the true GOD; but not honouring the SON as they honour the FATHER, their honour paid to the FATHER is not imputed to them. Disowning the authority of the SON which is derived from the FATHER, they rebel against the authority of the FATHER himself, prescribing laws and rules in Religion, after GOD has promulgated by the MESSIAH, his own SON, the means which he thinks fit to be embraced by mankind as the necessary qualifications for being his servants.

A philosophy which has no tendency to promote the Divine glory, nor any human good, deserves not to be complimented with a partial coolness towards

the

Note

the truth. The ſervice of God and man demands the diſcountenance of errour; for that being contrary to the light of truth leads to all the perplexities and horrours of darkneſs, in keeping clear from which our happineſs conſiſts.

This alſo deſerves our very ſerious conſideration, that if we have been deceived in matters which are the objects of ſenſe, and thereby eaſily determinable, as might have been imagined; how much more liable are we to deluſion in moral matters, where the ſubject may be ſo perplexed and diſguiſed, that a man hardly finds the way out of his own labyrinth, which he ſometimes forms to intangle and beguile others.

To conclude, As it is the unhappineſs of the human nature to be prone to errours, it is manifeſtly the buſineſs of us all to watch and guard againſt them. And when errours are viſible on one ſide, and truth is on the other, it is incumbent on us to quit the one, and to try at leaſt whether

whether that which is proposed as a Divine tradition, will bear the trial of an examination by facts and phænomena, which proved the workmanship of the *Copernican* system to be erected without a foundation.

The end of the first volume.
